Mediators and Moderators of Self-injurious Behaviours and Borderline Personality Disorder.

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Dedication

In memory of my parents, Graham and Stella Neale, who never got to see the finished product, but who I know would be proud.

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Abstract

Self-harm is a diagnostic criteria of Borderline personality disorder (BPD), and is a significant mental health problem in its own right. Three studies (*N*s=46 - 340) are reported that investigated the role of executive functions, attachment orientation, and social cognition as potential mediators and moderators of the relationship between BPD features and self-harm in a non-clinical sample. Findings from Study 1 indicated that personality and attentional control factors interact to determine self-harm likelihood whereby high attentional focusing and shifting abilities are protective when BPD features are low but high focusing may be a possible maintaining factor when BPD features are high. Findings from Study 2 indicated that the individuals who have previously self-harmed exhibited EF deficits compared to controls, particularly deficits primarily related to problem solving, difficulty disengaging attention, and cognitive switching. However, these differences did not influence the relationship between BPD features and self-harm. Instead, self-esteem mediated the relationship between BPD and intent to self-harm after exposure to the vignettes. In Study 3, findings revealed that global self-esteem and attachment anxiety completely mediated the relationship between BPD features and intent to self-harm after exposure to the vignettes. The findings of this study have a number of important implications for definitions, theoretical conceptualisations, and therapeutic interventions.

Candidate's Statement

This is to certify that the research described in this thesis is solely my own work. A complete reference list and Appendices are included.

Signature:

Total Words: 62, 522

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List of Abbreviations

The following list describes the significance of various abbreviations and acronyms used throughout the thesis.

Abbreviation	Meaning
AAI	Adult Attachment Interview
ACC	Anterior Cingulate Cortex
ACS	Attentional Control Scale
ADHD	Attention-Deficit Hyperactivity Disorder
ANT	Attentional Network Task
APA	American Psychiatric Association
ASPD	Antisocial Personality Disorder
BN	Bulimia Nervosa
BNC	British National Corpus
BOLD signal	Blood Oxygenation Level-dependant Signal
BPD	Borderline Personality Disorder
BPS	British Psychological Society
CATI	Coolidge Axis-II inventory
CBT	Cognitive Behaviour Therapy
CI	Confidence Interval
dACC	Dorsal Anterior Cingulate Cortex
DBT	Dialectical Behaviour Therapy
D-KEFS	Delis Kaplan Executive Function System
DLPFC	Dorsolateral Prefrontal Cortex
DSHI	Deliberate Self-Harm Inventory
DSM	Diagnostic and Statistical Manual of Mental Disorders
DTI	Diffusion Tensor Imaging
EC	Effortful Control
ECR	Experiences in Close Relationships Questionnaire
EEG	Electroencephalography
EF(s)	Executive Function(s)
ERP	Event-Related Potential
f	Female
FA	Fractional Anisotropy
FDG-PET	[^{18}F]Deoxyglucose Positron Emission Tomography
FFM	Five-Factor Model of personality
fMRI	Functional Magnetic Resonance Imaging
FWE	Familywise Error Rate
HCs	Healthy Controls
IGT	Iowa Gambling Task
IMR	Internet Mediated Research
IQ	Intelligence Quotient
K-F-FREQ	Kucera and Francis Written Frequencies
KS	Kolmogorov-Smirnov statistic

m	Male
MBT	Mentalization-Based Therapy
MD or MDD	Major Depression or Major Depressive Disorder
MRI	Magnetic Resonance Imaging
MRS	Proton Magnetic Resonance Spectroscopy
N/n	N = Total Number of Participants, n = Number of Participants in a group
NA	Negative Affect
NICE	National Institute for Health and Care Excellence
NHS	National Health Service
NSSI	Non-Suicidal Self-Injury
OFC	Orbitofrontal Cortex
OPD	Organic Personality Disorder
PA	Positive Affect
PAI-BOR	Personality Assessment Inventory – Borderline Scale
PANAS	Positive And Negative Affect Schedule
PD	Personality Disorder
PET	Positron Emission Tomography
PFC	Prefrontal Cortex
PTSD	Post-Traumatic Stress Disorder
REC	Research Ethics Committee
RSES	Rosenberg Self-Esteem Scale
RT(s)	Reaction Time(s)
SAS	Supervisory Attentional System
SCATI	Short Coolidge Axis II Inventory
SCID-II-PQ	Structured Clinical Interview for DSM-IV Axis II Personality Disorders Screening Questionnaire
SIB	Self-Injurious Behaviour
SST	Stop-Signal Task
STEPP	Systems Training for Emotional Predictability and Problem Solving
TAT	Thematic Apperception Test
TBI	Traumatic Brain Injury
TFP	Transference-Focused Psychotherapy
T-L-FREQ	Thorndike-Lorge Written Frequencies
WCST	Wisconsin Card Sorting Test
WM	Working Memory

Chapter 1: Introduction

1.1 Overview of Thesis Topics

Self-harm refers to intentional and direct injuring of one's body tissue (Klonsky, 2007) that is usually performed impulsively (Nock & Prinstein, 2005). Cutting, carving, and burning the skin are generally the most commonly reported behaviours (Gratz, 2001; Hawton, Rodham, Evans & Weatherall, 2002). However, self-harm can also be used to describe a wider range of self-damaging behaviours such as self-poisoning, overdose of medication, and attempted hanging (Skegg, 2005). Importantly, self-harm is not typically driven by suicidal intent and so is usually considered distinct from suicidality (Whitlock, Eckenrode & Silverman, 2006); however repetitive self-harm is strongly associated with an increased risk of suicide (Hawton, Zahl, & Weatherall, 2003; Zahl & Hawton, 2004). Self-harm has around a 21% prevalence rate in a typical clinical psychiatric sample, and around 4% in a general sample (Briere & Gil, 1998).

Self-harm behaviour also plays a central role in Borderline Personality Disorder (BPD), to the extent it is one of the diagnostic criteria (American Psychiatric Association (APA), 2013). It has even been described as the 'behavioural speciality' of those with BPD (Mack, 1975, cited in Sansone, Gaither, & Songer, 2002, p. 215). Up to 90% of BPD patients report multiple episodes of self-harm, with cutting and burning the skin being the most common (Zanarini et al., 2008). Individuals affected with BPD report a wide range of other dysregulated and self-damaging behaviours, such as drug abuse and disordered eating (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004). Given the importance of self-harm to BPD, it is surprising that potential pathways to self-harm behaviour are not particularly well understood (Glassman, Weierich, Hooley, Deliberto, & Nock, 2007).

Research suggests that individuals likely self-harm for a number of reasons. Self-harm is most commonly conceptualised as an affect regulation mechanism employed to make the individual feel better in some way, often as a distraction from painful and unwelcome negative emotions (Brown, Comtois, & Linehan, 2002; Gratz, 2003; Klonsky, 2007, Linehan, 1993). Self-harm may also be employed as an anti-dissociation mechanism by re-affirming an individual's desire to feel (APA, 2013), or as a way of reinforcing interpersonal boundaries (see Klonsky, 2007 for a review of the functions of self-harm). Affect regulation is the most commonly endorsed reason for self-harm by both clinical and non-clinical samples of individuals, but exactly how self-harm influences affect is currently unclear, it is not known if self-harm reduces negative affect, it increases positive affect, or both (Klonsky, 2007).

Although the aetiology of self-harm behaviour in general is not clear, it has been suggested that self-harm may occur because of executive dysfunction. This is because neuroimaging studies of BPD patients have shown structural and metabolic abnormalities in the fronto-limbic areas of the brain which are related to self-regulation, impulsivity, aggression, cognitive and emotion regulation (LeGris & van Reekum, 2006); all of which may contribute to self-harm. This is further supported by studies that show individuals with BPD consistently exhibit deficits in executive functions (Ayduk et al., 2008; LeGris & van Reekum, 2006).

Executive Functions (EFs) are a broad concept generally considered to be a range of metacognitive capacities that organise and influence other cognitive, emotional, and behavioural processes (Barker, Andrade, Romanowski, Morton & Bowles, 2010). Therefore, executive dysfunction typically manifests as a cluster of deficiencies, such as difficulty initiating, modifying, and inhibiting behaviour (D'Esposito & Gazzaley, 2005), poor decision making and response inhibition

(Minzenberg, Poole & Vinogradov, 2008), and deficiencies in attention and self-awareness (Mateer, 2000). EFs are a set of complex functions which form the basis of many cognitive, social, and emotional skills (Lezak, Howieson & Loring, 2004), it is logical that EFs play an important role in emotional regulation, and indeed EFs and emotion regulation appear to share overlapping brain regions and networks (Bush, Luu, & Posner, 2000). Therefore, deficits in EFs will manifest in emotional and behavioural dysregulation, as well as cognitive dysregulation (LeGris & Van Reekum, 2006).

It has been suggested that the core behavioural and emotional difficulties seen in BPD may have a basis in deficient EFs. Indeed, 86% of studies showed some degree of impairment in EFs in BPD patients (LeGris & van Reekum, 2006). Individuals with BPD exhibit an inability to disengage their attention from negative stimuli (Gyurak, Goodkind, Kramer, Miller, & Levenson, 2012a; von Ceumern-Lindenstjerna, Brunner, Parzer, Fiedler, & Resch, 2009). In addition, they also have difficulties in decision making on cognitive tasks (LeGris, Links, van Reekum, Tannock & Toplak, 2012), and display a consistent inability to inhibit responses, such as during the Stroop task (Black et al., 2009; LeGris et al., 2012). Furthermore, Stroop interference is a significant statistical predictor of suicide risk in BPD (LeGris et al., 2012). Crucially, individuals with BPD have extreme difficulty controlling their emotions (Holm & Severinsson, 2008). Emotional dysregulation is the core of Linehan's (1993) influential conceptual model of BPD, and it is consistent with the affect regulation model of self-harm (Brown et al., 2002; Gratz, 2003; Klonsky, 2007).

However, whilst research has linked executive deficits to some symptoms of BPD, there is relatively little research into the specific neuropsychological basis of self-harm in the general population. If the reason self-harm is driven by affect

regulation, then it seems plausible that emotional regulation difficulties may be influenced by underlying EF deficits. Difficulty disengaging from negative emotions, difficulty inhibiting behaviours, and poor decision making processes (all components of EFs) probably contributes to self-harm behaviour. Therefore, this research programme will address gaps in the current literature by exploring which neurocognitive mechanisms, in particular the executive functions, contribute to self-harm behaviours and BPD features.

In an attempt to understand how and why executive functions may be compromised in BPD and in individuals who self-harm, some researchers have used attachment theory as a theoretical framework. The attachment-based models of BPD (e.g., Meyer & Pilkonis, 2005) argue that disturbed attachments are central to BPD psychopathology. Levy (2005) argues that the interactions between a child and its caregiver lead to the child building 'internal working models' (representations) of themselves and others. These internal working models can then affect personality development as they guide relationship expectations and behaviour throughout the lifespan. In the case of BPD, it is argued that the core symptoms such as intense and unstable interpersonal relationships fear of abandonment, rage and anger, and a lack of a sense of self, stem from impairment in the underlying attachment organisation (Levy, 2005). A review of the literature by Agrawal and colleagues (2004) concluded that there was a strong association between BPD and insecure forms of attachment, and in particular with unresolved, fearful, and preoccupied attachment styles. Individuals' with these attachment styles long for intimacy, yet are simultaneously concerned about dependency and rejection. These insecure attachment patterns seen in BPD patients may exacerbate certain symptoms, for example anger, self-harm, and fear of abandonment could be triggered by an

interpersonal context, or what Holmes (2004) terms an 'attachment crisis'. With respect to self-harm, individuals with insecure attachment are more likely to engage in self-harm than those with secure attachment (Suyemoto, 1998), and anxious attachment styles in particular increase the risk of self-harm and suicide related behaviours (Stepp et al, 2008). Yates (2004) argues that this is because negatively biased representations of the self and others lead to an expectancy of rejection and an over-reliance on others for approval, consequently causing isolation from the social world and its supports. In the absence of adaptive coping mechanisms and social support, maladaptive coping strategies can develop, particularly in the context of interpersonal distress and traumatic events.

Development of attachment styles has been linked to neurobiological development, whereby early experiences of caregiving are imprinted on to the limbic system (Schore, 1994). This occurs because emotion regulation in the first few weeks of life is regulated by the caregiver, but becomes increasingly self-regulated during the course of childhood (Schore & Schore, 2008). Early caregiving experiences can be regulated, which imprint secure attachment, or dysregulated, which imprints insecure attachment styles (Schore & Schore, 2008). Because the right hemisphere of the brain is maturing at this time, and has deep connections to the limbic system, attachment experiences specifically affect developing limbic and cortical areas of the right brain network that are essential for self and emotion regulation in later life (Schore, 2005). Thus, attachment styles may be linked to executive function development in childhood and may be related to self-harm behaviour in adults.

This research summarised in the previous paragraph has potentially far reaching implications for the theory and clinical practice, as understanding the nature

and function of self-harm can lead to more effective avenues of research and practice. Research shows that deficits in EFs seem to be amenable to training and interventions (Miyake & Friedman, 2012). Indeed, some psychotherapies for BPD include techniques that are conceptually similar to EF training. For example attentional control training (Selby, Anestis, Bender & Joiner, 2009), mindfulness (Linehan, 1993), and mentalization (Eizirik & Fonagy, 2009) based psychotherapies teach skills that help individuals with BPD distract themselves from their negative emotional internal states. If the findings from this series of studies can identify which particular EFs are implicated in self-harm, this can be used in order to inform treatment options for specifically targeted interventions or skills training.

This thesis contains a series of three studies that addressed gaps in the current research, namely the understanding of the potential mediators in the relationship between BPD and self-harm. Initially, these studies were designed to explore how executive functions and BPD features interact and their effect on self-harm. Based on these findings, subsequent studies activated the attachment system to explore if and how it influenced the relationships among executive function, BPD features, and self-harm. The studies presented in this thesis were designed to investigate both 'pure' cognitive processes (executive functions) and social cognitive processes (self and other evaluations in an interpersonal context) using a wide range of methods, including self-report measures, standardised neuropsychological tests of executive function, and bespoke cognitive tasks (e.g., an attachment based Stroop task).

1.1.1 The Normal Personality

Although BPD has been discussed briefly, there can be no meaningful understanding of personality disorders without first understanding what is meant by

'personality'. Personality and psychopathology have a bidirectional pathoplastic relationship, meaning that they can influence the presentation or appearance of one another, and may share an underlying aetiology (Widiger, Verheul, & van den Brink, 1999). 'Personality' is defined as "the characteristic manner in which one thinks, feels, behaves, and relates to others" (Widiger et al., 1999, p. 347). Mental disorders (including personality disorders) are defined as significant impairments in one or more areas of psychological functioning, which can include thinking and feeling (APA, 2013). Therefore, the presentation, course, and treatment of a mental disorder would be significantly affected by a person's premorbid personality structure (Widiger, 2011).

Clearly the mental disorders that most relate to personality are the personality disorders. Studies looking at the relationship between personality and personality disorders (e.g., Costa & Widiger, 1994) hypothesised that personality disorders, as defined by the APA's (1987) Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R), represented maladaptive variants of normal personality traits that are evident in all persons to varying degrees. Following on from this, numerous researchers have used the Five-Factor dimensional model of normal personality functioning (FFM) to attempt to integrate personality theory and personality disorder research. The FFM is considered to represent a dimensional model of the structure of normal personality traits, and is divided into five broad dimensions of Neuroticism, Extraversion, Openness (to experience), Agreeableness, and Conscientiousness (Costa & McCrae, 1992).

A contemporary meta-analysis by Saulsman and Page (2004) of the literature on the relationship between the FFM and the 10 personality disorders listed in the DSM-IV (APA, 2000) found that most PDs involved high levels of Neuroticism and

low levels of Agreeableness. They therefore concluded that personality disorders can be conceptualised using the FFM of normal personality functioning, but stressed that these conceptualisations are better for some disorders than others. For example, there were much larger effect sizes for BPD and Avoidant Personality Disorder than for Obsessive-Compulsive Disorder and Schizoid PD. In relation to the FFM, Costa and Widiger (1994) argued that BPD primarily involves the traits of excessive neuroticism and antagonism, as they encompass much of the BPD pathology such as anger, hostility, impulsivity, and depression. They argued that BPD should therefore be reconceptualised as a disorder of extreme neuroticism. This view is also supported by findings from Trull and colleagues (2003), who found support for the hypothesis that BPD is a maladaptive variant of FFM personality traits.

There is an increasing consensus that normal and abnormal personality structure is essentially the same in both clinical and non-clinical populations, (O'Connor, 2002; O'Connor & Dyce, 2001; Costa & Widiger, 1994) and may share an underlying aetiology (Jang & Livesley, 1999; Markon, Krueger, Bouchard, & Gottesman, 2002). This view that personality and personality disorders are based on the same underlying structure is reflected in the latest version of the DSM-5 which was published in May 2013, and although the move to dimensionality within personality disorders was not fully accepted for inclusion, the DSM-5 adopted a hybrid dimensional-categorical model for personality disorders in section-III of the manual as a model for further study, in the hopes that this would encourage research to focus on the dimensional-categorical model (see section 3.2 for a discussion).

To receive a diagnosis of BPD in the DSM-IV-TR (APA, 2000), a person is required to meet five (or more) out of the nine criteria, but this lead to 256 unique

possible ways to meet the criteria (Trull, Distel, & Carpenter, 2011). This results in a large number of BPD variants and high heterogeneity among this population. This heterogeneity has proven challenging for clinicians and researchers, and has led to some authors arguing that the alternative view of dimensional measure of BPD, one that views personality pathology on a continuum could reduce heterogeneity (Chanen, 2009; Kim & Tyrer, 2010; Yeomans, Levy, & Clarkin, 2009).

However, some authors have argued that the moving towards a dimensional model presents its own problems; Skodol (2012) argues that dimensional models can end up overly complex, requiring clinicians to have a detailed understanding of trait domains and trait specific facets. Such models are not familiar to the majority of clinicians who are generally trained in the medical model that focuses on symptoms, diagnosis, and treatment, therefore they may find it more difficult to use and apply dimensional models based on psychological concepts such as traits (Skodol, 2011). Paris and colleagues (2009) argue that there is no empirical evidence to support that a more dimensional approach would increase validity for diagnosis of personality disorders.

Tyrer (2009) has extended the argument further and posits that BPD should not actually be considered a personality disorder. He argues that personality disorders in the DSM-IV (APA, 2000) are all described by variations in personality traits, except for schizotypal and borderline personality disorders. He argues that schizotypy is better suited to the context of schizophrenia and related disorders; whereas borderline may be better placed as a mood disorder due to the central role of negative affect in BPD. Tyrer further argues that BPD as it is currently conceptualised should be abolished, and needs redefining and reformatting, as it does not fit within the context personality disorders and is simply a "passport to

heterogeneity" (p. 94). Not all authors agree with Tyrer's position, Paris and colleagues (2009) argue that while affective instability may be a core component of BPD, it does not capture or explain all the symptoms associated with BPD. Impulsivity and disturbed relationships appear to be of equal importance. In addition, individuals with BPD often suffer from cognitive symptoms as part of the disorder, such as dissociation, paranoia and hallucinations (Paris, Silk, Gunderson, Links, & Zanarini, 2009). Cognitive symptoms may signify an additional level of complexity that does not fit with mood disorders (Yeomans et al., 2009), in addition mood stabilising medication does not appear to be particularly beneficial in stabilising affect in BPD (Olabi & Hall, 2010).

In line with the current conceptualisations of personality disorders discussed in this section, which regard PDs as maladaptive variants of normal personality traits (e.g., APA, 2013; Costa & Widiger, 1994; O'Connor, 2002; O'Connor & Dyce, 2001), the perspective taken in this thesis is that personality disorders are considered and measured as a hybrid-dimensional model. This conceptualisation takes into account the continuous variation in severity of BPD features derived from the categorical classification system.

1.2.1 On Studying Personality Disorder Features and Self-harm in Non-clinical Samples

In this thesis I present three studies that investigate the clinically relevant behaviours of self-harm and BPD features in a non-clinical population. It could be argued that this is problematic as a clinical population would appear to be the most appropriate samples for investigating such clinical constructs. However there are a number of theoretical and empirical justifications to support the approach taken in this thesis. Self-harm is common in non-clinical populations (Brickman et al., 2014;

Drabble, Bowles & Barker, 2014), with around a 4% prevalence rate in a general sample (Briere & Gil, 1998; Klonsky, Oltmans & Turklehimer, 2014) and many individuals who self-harm may not seek clinical treatment due to the secrecy and shame associated with the behaviour (Hawton & James, 2005). The existing research generally fails to address self-harm in non-clinical (or sub-clinical) populations, highlighting the necessity to investigate how BPD features might drive maladaptive behaviour (such as self-harm) in non-clinical groups.

BPD features are relatively prevalent in non-clinical samples (Torgersen et al., 2001). Individuals in non-clinical samples who report relatively high levels of BPD features suffer from significant social, occupational and academic dysfunction (Bagge et al., 2004; Trull, Useda, Conforti, & Doan, 1997). Young adults with BPD features have poorer outcomes than their non-BPD peers, including social maladjustment and poorer academic performance (Bagge et al., 2004). As BPD has a more gradual onset typically starting in adolescence or early adulthood (APA, 2013), some symptoms would almost likely be present before an individual would meet the full criteria for a diagnosis, and BPD features in adolescence bear a strong resemblance to the BPD diagnosis in adults (Bradley et al., 2000).

Additionally, there may be a qualitative difference in the experience of BPD features between clinical and non-clinical samples. It has been argued that clinical samples may not be representative of all people with a disorder (Goodman et al., 1997) because they are likely the most severe cases (Bagge et al., 2004). In addition, recruiting participants from clinical settings may increase the chances of recruiting patients at their most impaired point or during a crisis (Shea et al., 2002). Non-clinical samples that exhibit BPD features are likely to be more representative of BPD in the general population, and also have the advantage of less confounding

factors such as previous treatment (e.g., Shea et al., 2002), psychotropic medication (e.g., Zanarini, 2004), and have less distorted evaluations of themselves (Davis, Claridge, & Cerullo, 1997).

That BPD features can be meaningfully identified in non-clinical samples (e.g., Bowles & Meyer, 2008; Bowles et al., 2013 Dreessen et al., 1999; Meyer, Ajchenbrenner & Bowles, 2005; Torgersen et al., 2001), and are sufficient to predict a range of outcomes (e.g., Bagge et al., 2004; Trull et al., 1997) supports the dimensional nature of BPD and the importance of studying it in non-clinical samples (Trull et al., 1997). Trull and colleagues (1998) argued there was "no compelling rationale or previously published work suggesting a differential effect of changes... might be observed depending on the clinical status of study participants" (p. 196). This is consistent with contemporary theories that normal and abnormal personality structure is essentially the same in both clinical and non-clinical populations (O'Connor, 2002; O'Connor & Dyce, 2001; Costa & Widiger, 1994), which is reflected in the latest version of the DSM-5. Taken together, the evidence supports the approach taken in this thesis which considers personality disorders to be better represented on a continuum rather than categorical, and highlights the importance of exploring samples with a wide range of BPD features (Bagge et al., 2004).

1.2 Key Definitions and Current Status

1.2.1 Self-harm.

There is currently no comprehensive classification for self-harm behaviours (Latimer, Covic, & Tennant, 2012). Technically it covers a wide range of behaviour from the extreme types of behaviour seen in psychotic episodes (e.g., enucleation, autocastration), indirect self-harm through risky behaviours (Sansone, Wiederman, & Sansone, 1998), and less severe types of self-harm such as cutting and burning the

skin, which is the type most commonly seen in BPD and the general populations (Soloff, Lis, Kelly, Cornelius, & Ulrich, 1994; Klonsky, 2007). Definitions typically exclude self-harm that occurs as a result of serious psychopathology or organic impairment such as psychosis (Mangnall & Yurkovich, 2008), and socially sanctioned behaviours such as tattoos and piercing. However, the latter could be considered a form of self-harm if the individual was indiscriminately tattooing/piercing themselves to produce pain or discomfort, as opposed to for cosmetic reasons (Campbell, 2008).

Self-harm, also described as deliberate self-harm, self-injury, Self-injurious behaviour (SIB), nonsuicidal self-injury (NSSI), self-mutilation, and parasuicide, typically refers to intentional and direct injuring of one's body tissue which is not driven by suicidal intent (Klonsky, 2007). However, not all self-harm behaviours cause tissue damage. For example, exercising to exhaustion, or overdosing on medication typically co-occurs with usual self-harm behaviours (Skegg, 2005). Self-harm can involve wide-ranging behaviours, from the most commonly reported such as cutting, to more severe types such as breaking bones or falling/jumping from high areas (Laye-Gindhu & Schonert-Reichl, 2005). Self-harm can also encompass highly lethal behaviours such as self-strangling or asphyxiation, and self-poisoning (Jacobson, Muehlenkamp, Miller & Turner, 2008).

The APA (2013) currently include self-harm as a criterion of BPD, and as a standalone disorder (non-suicidal self-injury disorder) as a condition for further study in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) because self-harm is regarded as a major problem and a public health issue that needs to be better understood. The case for including non-suicidal self-harm as a new diagnostic category and disorder has been controversial, some researchers

argue that this will lead to better research and treatment of self-harm (Wilkinson, 2013), whilst others have raised concerns that the diagnostic criteria have been prematurely concretised without sufficient research (Zetterqvist, Lundh, Dahlström, & Svedin, 2013). For example, the DSM-5 emphasises repetition of self-harm, individuals would need to report five or more instances of self-harm within the previous year to meet the criteria for NSSI disorder. The DSM-5 also states that the essential feature of nonsuicidal self-injury is repeatedly inflicted, shallow yet painful injuries to the body that is most commonly performed to reduce negative affect or to resolve interpersonal difficulties. This affect regulation hypothesis is consistent with other major theories and definitions of self-harm (e.g., Brown et al., 2002; Gratz, 2003; Klonsky, 2007; Linehan, 1993; Soloff et al., 1994), however it is a somewhat narrow definition which excludes forms of self-harm other than those that cause tissue damage or are performed for reasons other than affect or interpersonal reasons. It is important to note that the rationale for including non-suicidal self-injury disorder is to stimulate further research in order to clarify self-harm into a meaningful construct, therefore the criteria are necessarily less rigorous and more malleable than the diagnostic criteria for established disorders included in the DSM-5 (see section 2.3 for a discussion).

1.2.2 Borderline personality disorder.

Individuals with BPD have great difficulty in exerting control over their unstable and often extremely negative emotions (Holm & Severinsson, 2008). It is this emotional dysregulation that is a core feature of BPD, and is believed to underlie many of its problematic behaviours, self-harm and suicidal gestures in particular (Linehan, 1993). Individuals affected with BPD report a wide range of other dysregulated and self-damaging behaviours over and above self-harm, such as drug

abuse, and disordered eating (Lieb et al., 2004). It is thought that the inability to regulate emotions leads to preoccupation and frustration with negative emotions, which becomes so unbearable that they may be more likely to rely on maladaptive strategies such as self-harm (Gratz & Roemer, 2008; Gratz, Breetz, & Tull, 2009; Korner, Gerull, Stevenson, & Meares, 2007). As in non-clinical samples, self-harm is not typically driven by suicidal intent in BPD (Whitlock et al., 2006); indeed suicidality is also a separate diagnostic criterion for BPD.

1.2.3 Executive functions.

Unlike other cognitive domains (e.g., memory, attention), there is no intuitive lay concept of executive functions (Elliot, 2003). 'Executive function(s)' (EF) is an umbrella term that refers to a range of metacognitive capacities (higher-order attentional and control processes) that co-ordinate/maintain, initiate or inhibit other cognitive and emotional processes (Miyake et al., 2000; Barker et al., 2010; Morton & Barker, 2010) and govern self-ordered, context-appropriate and goal-directed activity (Baddeley & Wilson, 1988; Burgess & Shallice, 1996a & 1996b; Strauss, Sherman & Spreen, 2006; Burgess, 2003). Executive functions are often discussed synonymously with frontal lobe function (Stuss & Alexander, 2000), and neuroimaging studies appear to show that the prefrontal cortex is strongly bound up with some executive functions (Miller & Cohen, 2001; Silbersweig et al., 2007). However, Strauss, Sherman and Spreen (2006) agree that anatomical labels should be avoided in order to avoid confusion, because optimum EF performance requires intact frontal and non-frontal brain regions (Alvarez and Emory, 2006) as well as efficient connectivity among regions (Kinnunen et al., 2010).

Consequently, Baddeley and Wilson (1988) preferred the term 'dysexecutive syndrome' over 'frontal lobe syndrome', because it emphasises the functional pattern

of deficits rather than an anatomical location. Dysexecutive syndrome refers to the common pattern of symptoms resulting from impaired EFs, usually as a result of brain damage. Symptoms of dysexecutive syndrome fall into three broad categories: cognitive, behavioural, and emotional. Cognitive symptoms include deficits in attention and self-awareness (Mateer, 2000); behavioural symptoms include poor decision making (Minzenberg, Poole & Vinogradov, 2008) and difficulty initiating, modifying, and inhibiting behaviour (D'Esposito & Gazzaley, 2005); and emotional symptoms include irritability and impulsive aggression (Cattran, Oddy, & Wood, 2011).

Disturbances in emotion regulation following brain injury are common (Cattran et al, 2011). This is not surprising given that the evidence suggests that EFs play a critical role in emotion regulation (Gyurak et al., 2012a). Successful emotional regulation requires at least some of the components of the executive functions, such as planning, monitoring and executing responses, and inhibiting unhelpful behaviours and cognitions (Gyurak et al., 2012a). Furthermore, neuroimaging studies have found considerable functional overlap among brain structures (e.g., the anterior cingulate cortex) that appear to support both EF processes and the processing emotional stimuli (Bush, Luu, & Posner, 2000). This suggests that EFs play a crucial role as part of a circuit that serves to regulate both cognitive *and* emotional processes (Bush, Luu, & Posner, 2000).

1.2.4 Attachment theory.

Childhood experiences have long been considered and important factor influencing the development of personality and psychopathology. Orlansky (1949) claimed that: "The importance of childhood experience to the formation of personality was one of the great findings of psychoanalysis" (p. 1). Attachment theory is based

on John Bowlby's model of early human development and emphasises the importance and quality of infant-caregiver interactions to development of personality, and to later psychological well-being or psychopathology. Internal working models of the self and others (mental representations) are central to attachment theory, and early positive attachment experiences (when attachment needs are met routinely) promotes a sense of 'felt security' (Sroufe & Waters, 1977), which promotes the development of positive representations of the self and others. Conversely, negative attachment experiences can cause disruptions in the attachment system promoting the development of insecure attachment styles (Pearlman & Courtois, 2005), potentially leading to negative (or conflicted) self and other representations. Therefore, attachment theory is a model of both normal development and psychopathology.

Attachment theory is one of the most influential theories in relation to childhood social development (Rutter, 1995), and has been applied to many psychopathological conditions (see Atkinson & Goldberg, 2003, for a review), including personality disorders. Researchers frequently use attachment theory to explain interpersonal and social cognitive difficulties in BPD (e.g. Meyer & Pilkonis, 2005), as symptoms (including self-harm) often arise in an interpersonal context as a reaction to real or perceived abandonment (APA, 2013). However, there is limited research regarding the mechanisms that account for this link between BPD features and attachment insecurity (Beeney et al., 2015).

One theory is that attachment insecurity exerts an effect on BPD features via social cognition (i.e., processing of information pertaining to the self and others). Individuals with BPD typically have predominantly negative internal working models of themselves self and others (Lazarus, Cheavens, Festa, & Rosenthal, 2014), and

these negative representations can lead to disturbances in social cognitive processes. There is strong evidence that social cognition is impaired in BPD across many domains, including negatively biased self-other representations, disturbed emotional processing, rejection sensitivity, and identity diffusion (Lazarus et al., 2014). For example, individuals with BPD display increased reactivity to interpersonally stressful situations (Lazarus et al., 2014), which can further exacerbate BPD features such as fear of abandonment. In addition, this interpersonal sensitivity can further interfere with the ability to establish and maintain stable and supportive relationships (Brennan, Clark & Shaver, 1998; Meyer & Pilkonis, 2005).

Exactly how attachment experiences influence the development of cognitive and social processes in not known. Schore (1994; 2000; 2005) has written extensively on the subject of attachment and neuropsychology, and has implicated certain brain regions (the right fronto-limbic areas of the brain) which may underlie both attachment and cognitive development. Schore's regulation theory argues that poor or inconsistent attachment experiences in childhood negatively influence the early development and organisation of cortical and limbic areas of the right brain network, which are critical to self and emotion-regulation. Attachment pathology will therefore manifest as social cognitive deficits, due to the limited capacity to process socioemotional stimuli (Schore, 2005). Attachment experiences in adolescence can also exert a similar effect on cognitive and social cognitive development; adolescence represents a critical period of brain development for affective and social cognitive functions as the brain matures (Blakemore & Choudhury, 2006). Taken together, the evidence suggests that attachment experiences continue to influence the development of cognitive and social cognitive processes into adulthood.

Negative or inconsistent attachment experiences can result in deficits in cognitive and social cognitive processing, which may contribute to the onset and maintenance of psychopathology.

Chapter 2 Self-Harm

2.1 Clinical Features of Self-harm

The most commonly reported self-harm behaviours are cutting (e.g., cutting, carving, scratching, or poking the skin) and burning the skin (Gratz, 2001; Hawton, Rodham, Evans & Weatherall, 2002). These methods pose the risk of scarring, serious infection, and in severe cases can require the attention of plastic surgeons (Wraight, Belcher, & Critchley, 2008). However, types and lethality of self-harm behaviours can vary widely and can range from relatively superficial skin damage to more severe types of injury such as breaking bones (Laye-Gindhu & Schonert-Reichl, 2005), and highly lethal behaviours such as self-strangling, asphyxiation, and self-poisoning (Jacobson et al., 2008).

Although some self-harm behaviour that is of high lethality can resemble suicide attempts, self-harm is generally considered distinct from suicidal ideation and behaviours, but the relationship between self-harm and suicidality is complex and not yet fully understood (Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006). Previous research has indicated that self-harm is a major risk factor for suicide, and estimates suggests that around a quarter of suicides are preceded by an episode of self-harm (Owens, Horrocks, & House, 2002). In an adolescent sample, 70% of those who reported self-harm also reported at least one lifetime suicide attempt, and 55% reported multiple suicide attempts (Nock et al., 2006). Recent research suggests that individuals who self-harm and go on to attempt suicide can be distinguished from those who only self-harm by greater levels of depressive symptoms and suicide ideation, along with lower levels of self-esteem and perceived parental support (Brausch, & Gutierrez, 2010). Although it appears that self-harm and suicide are qualitatively distinct phenomena, suicide risk among individuals who

self-harm is hundreds of times higher than in the general population (Owens et al., 2002). A considerable amount of literature has been focused on self-harm in the context of a BPD diagnosis, or in adolescents (e.g., Klonsky & Muehlenkamp, 2007; Nock et al., 2006; Wilkinson & Goodyer, 2011), but the existing research generally fails to address self-harm in adult non-clinical populations. Self-harm is often present outside of the context of BPD, so it is possible that individuals who self-harm outside of a BPD diagnosis may form a distinct category of the self-harming population (Selby, Bender, Gordon, Nock, & Joiner, 2012).

2.2 Epidemiology and Aetiology of Self-harm

2.2.1 Epidemiology.

Self-harm is relatively rare before puberty, with a common age of onset around 16 years old, and the greatest risk for hospitalisation is typically in women aged 15–24 years, and men aged 25–34 years (Skegg, 2005). Older individuals who self-harm are much more likely to commit suicide following an episode of self-harm than their younger counterparts (Hepple & Quinton, 1997). It is unclear whether self-harm is more common in women than men as the research has been inconsistent; some researchers typically consider it more common in women (e.g., Suyemoto, 1998) but other research has found comparatively equal occurrence in both sexes (Briere and Gil, 1998; Klonsky, 2007; Skegg, 2005). Estimates show that admittance to UK hospitals for self-inflicted injuries is approximately 140,000 - 170,000 cases per year (Hawton et al., 2007), and that individuals who self-harm are at an increased risk of suicide (Hawton, Zahl & Weatherall, 2003; Hawton & Harriss, 2007). In addition, self-harm methods that damage the skin can pose the risk of serious infection and permanent scarring (Wraight et al., 2008). Self-harm therefore

places a considerable burden on National Health Service (NHS) resources (Haw, Bergen, Casey, & Hawton, 2007).

2.2.2 Aetiology.

It is not entirely clear why some individuals choose self-harm over other coping mechanisms. One possibility is that some individuals have difficulty adopting more adaptive coping mechanisms, or adopt ineffective coping methods such as rumination and self-blame, which can exacerbate negative emotions further (Mikolajczak, Petrides, & Hurry, 2009). If individuals have no other way of coping with or regulating their emotions, they are more likely to rely on maladaptive strategies such as self-harm (Gratz & Roemer, 2008; Gratz, Breetz, & Tull, 2009). As self-harm is generally considered to serve multiple purposes, such as decreasing negative affect or to relieve dissociation, psychological models of self-harm have tended to formulate models based on these behavioural functions (Nock, 2009). The functional model of self-harm, proposed by Nock and Prinstein (2004) was developed from the findings that suggest the reason most people engage in self-harm is related to automatic reinforcement, as they most commonly employ self-harm as a mechanism to regulate (i.e., both decrease and increase) emotional and physiological experiences.

That self-harm acts as an affect regulation mechanism (i.e., to either increase or decrease emotional experiences) is well supported in the research, as a number of studies identify affect regulation as the primary reason for self-harm (Brown et al., 2002; Gratz, Breetz, & Tull, 2009; Gratz & Roemer, 2008; Klonsky, 2007; Nock, 2009; Nock & Prinstein, 2004; Suyemoto, 1998). In an experimentally induced pain paradigm, Bresin and colleagues (2010) found that individuals with high emotional reactivity were more sensitive to emotional stimuli, and experienced more intense

and prolonged duration of negative emotions than those low in emotional reactivity. Importantly, those highly emotionally reactive individuals experienced a significant decrease in negative affect after experiencing pain, than those low in emotional reactivity. This suggests that some individuals may be able reduce their negative affect by experiencing physical pain, and lends support to the affect regulation model of self-harm.

'Affect regulation' is generally considered to be an umbrella term, and research suggests that it actually consists of a variety of lower level functions. Individuals may self-harm for a variety of affect related reasons, these include reducing negative affect and arousal, as an anti-dissociation mechanism (also referred to as 'feeling generation'), as a way of avoiding suicidal thoughts, reinforcing personal boundaries, self-punishment, or as a method of sensation seeking (Klonsky, 2007). These functions are not mutually exclusive and can co-occur as well as conceptually overlap. Although there is some tentative evidence to support that self-injury may reduce negative emotions (e.g., Bresin, Gordon, Bender, Gordon, & Joiner, 2010); these mechanisms are not yet fully understood (Klonsky & Muehlenkamp, 2007).

One theory that attempts to bridge the conceptual gap between internal emotion dysregulation and external behavioural dysregulation is the 'emotional cascade' model (see Figure 2.1) by Selby and colleagues (2008; 2009; 2015). Any emotion eliciting event or 'trigger' that induces negative affect can initiate the emotional cascade. The trigger event causes the individual to ruminate intensively, which increases focus towards the negative emotion and increases the intensity and duration. Consequently, the feedback loop between rumination and negative affect continues, increasing in intensity and resulting in a highly negative and unpleasant

emotional state. Minor distractions are insufficient to inhibit the cycle, and therefore a more potent form of distraction is required, such as self-harm. In effect, this 'short circuits' the cascade (Selby & Joiner, 2009), but as self-harm provides successful (albeit temporary) relief from these emotions, it then becomes a reinforcing behaviour, which likely contributes to its repetitive nature (Briere & Gil, 1998).

Therefore, when an individual is engaged in an emotional cascade, they may be at peak risk for engaging in impulsive behaviours in an attempt to distract from the feedback loop (Selby, Kranzler, Panza, & Fehling, 2015). Although the concept of emotional cascades is relatively new, findings generally support their existence and show a strong link with self-harm (Selby et al., 2008; 2010; 2013; Arbuthnott, Lewis, & Bailey, 2015). Selby, Connell, and Joiner (2010) argue that even though different reasons may be given for self-harming (e.g., self-punishment, affect regulation, anti-dissociation), they can generally be interpreted as a desire to distract from ruminating on negative emotions. Neuropsychological research has supported the emotional cascade model; depressive rumination is linked to deficits in inhibiting behavioural responses, thereby resulting in difficulty blocking or disengaging from negative emotions. Whereas, angry rumination is associated with attentional inflexibility, which results in difficulty switching attention from one set of thoughts to another (Whitmer & Banich, 2007). The emotional cascade model is conceptually similar to the experiential avoidance model of self-harm proposed by Chapman, Gratz, and Brown (2006), as both models conceptualise self-harm as a behaviour that reduces unwanted or unpleasant emotional responses.

Additionally, it appears that the effects of the emotional cascade is stronger in BPD, as BPD could be characterised as the extreme end of the continuum of emotional cascades and impulsivity (Selby et al., 2009; 2015; Selby & Joiner, 2010;

2013). Selby and colleagues (2009) found that individuals with high levels of BPD features had increased levels of negative affect and increased reactivity than healthy controls when rumination was induced. In addition, they found that the emotional cascade statistically mediated the relationship between BPD and the latent variable of behavioural dysregulation. The emotional cascade model may partially explain why some individuals choose to self-harm over other coping mechanisms, but further research is needed.

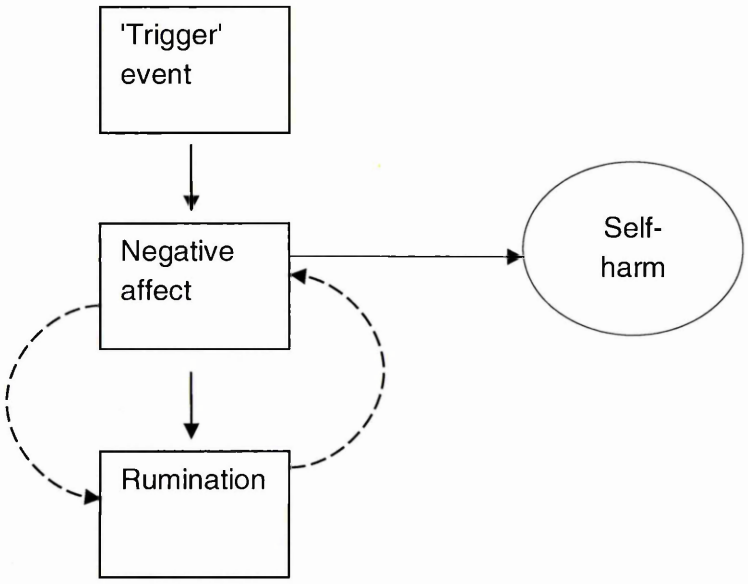

Figure 2.1 Simplified schematic of the Emotional Cascade Model of self-harm. As described by Selby and colleagues, (2009; 2010; 2013; 2015). Dashed lines denote increasing focus and intensity.

Although automatic reinforcement functions, such as reducing negative affect appear to be one of the most important functions of self-harm, social reinforcement functions may also play a role, as virtually every study looking at the social functions of self-harm found that a substantial number of individuals report using self-harm for interpersonal reasons (Nock, 2008). Interpersonal models of self-harm refer to self-harm as a way of regulating the social environment (Nock & Prinstein, 2004). For example, self-harm may be employed as a way of reinforcing personal boundaries or

to assert identity or autonomy (Suyemoto, 1998). Few studies have looked at the interpersonal boundaries function of self-harm, but those that have showed support as individuals reported using self-harm as a way of endorsing ownership or control over the body (Klonsky, 2007). More commonly, interpersonal models of self-harm typically consider self-harm as a way of communicating with, or influencing the behaviour of, others (Nock & Prinstein, 2004). In the context of BPD, it could be that self-harm occurs as a result of abandonment and rejection sensitivity, and may be used as a signal of distress to elicit a response from a caregiver (Nock, 2008) or as a cry for help (Klonsky, 2007). Interpersonal models have received much less attention in the research literature than affect regulation models, possibly because self-harm is generally considered to fundamentally be a private and secretive act (Gratz, 2003), which undermines the notion of self-harm as a method of communication. Additionally, even though self-harm behaviour may influence the behaviour of others, it does not necessarily follow that interpersonal influence is the primary motivator for the individual to self-harm (Nock, 2008).

2.3 Current Definitions and Diagnosis of Self-harm

The APA (2013) currently include self-harm as a criterion of BPD, and includes non-suicidal self-injury disorder (NSSI disorder) as a standalone disorder as a 'condition for further study' in the DSM-5. Although it is conceptualised as self-injury *disorder*, the definition of self-harm as an affect regulation mechanism "to obtain relief from a negative feeling or cognitive state, to resolve interpersonal difficulty, or to induce a positive feeling state" (APA, 2013, p. 803) and as a distinct entity from suicide, is largely consistent with other major theories of self-harm discussed in section 2.2.2). The major difference in the criteria for self-injury

disorder is that it emphasises five or more instances of self-harm within the previous year.

Because the proposal of recognising self-harm as a disorder in its own right is so recent, there has been little research into the validity and utility of the diagnostic criteria and the concept as a whole. Selby and colleagues (2012) conducted an exploratory study comparing the characteristics of participants who met the proposed criteria for self-harm disorder, to the well-established criteria of BPD and other DSM disorders, to aid in the determination of whether self-harm disorder should be considered a separate, valid diagnostic entity. The authors found similar levels of impairment (indicated by a measure of global functioning) and psychopathology in both those diagnosed using the self-harm criteria, and those diagnosed using the BPD criteria. Both the self-harm group and BPD group had significantly more impairment and more severe psychopathology than a healthy control group. However, the BPD group included more women and increased reports of previous childhood abuse.

A study by Zetterqvist and colleagues (2013) looked at the utility of the suggested DSM-5 criteria for self-harm disorder in a sample of Swedish adolescents. Their results showed significant differences between those who met the criteria, and those who reported self-harm but did not meet the full criteria for a diagnosis. Those who met the criteria perceived their families to have more financial difficulties, had more often lived with only one parent or lived alone/at an institution, and reported that their parents were unemployed or on long-term sick leave. Zetterqvist and colleagues also reported significantly worse health-related behaviours such as smoking, alcohol misuse, and drug use. Another interesting finding from the study was specifically related to criterion E: "The behaviour or its consequences cause

clinically significant distress". The authors' note that this could be problematic for diagnostic purposes because 25% of those who qualified for a diagnosis reported that self-harm was not a source of distress for them, instead it was more likely to be regarded as a mechanism to ease distress. A study by Andover (2014) also compared individuals who met the criteria for self-harm disorder to those who reported previous self-harm but did not meet all the criteria. Of those who qualified for a diagnosis, they did not differ significantly on age of onset, lifetime frequency, or number of self-harm methods used. They did differ in daily functioning, as those with NSSI Disorder were more likely to report that self-harm interfered with their daily functioning than those without. However, those with and without the disorder were equally likely to report that they wanted to stop engaging in self-harm and may be just as likely to seek treatment for the behaviour. Overall, these findings suggest that those who meet the criteria for the disorder may not necessarily exhibit increased or more severe forms of self-harm than those who engage in self-harm, but do not meet criteria.

Bracken-Minor and McDevitt-Murphy (2014) examined the differences in characteristics of self-harm between those who screened positively for BPD versus those screened negative. Participants who met the criteria for self-harm disorder (but not BPD) did not differ in age of onset, lifetime frequency, or number of self-harm methods used than those who did meet the criteria for a diagnosis of BPD. This is largely consistent with the findings from Andover (2014), that the presence of a clinical diagnosis does not necessarily reflect the severity of self-harm. In addition, the BPD-positive group were more likely than the BPD-negative group to report cutting and burning, two of the most common methods of self-harm. Both BPD-positive and BPD-negative groups heavily endorsed affect regulation as the main

function of their self-harm, but the BPD-positive group were more likely to endorse also using self-harm as a means of self-punishment and warding off suicide and dissociation.

Taken together, this research tentatively supports the existence of self-harm as a disorder in its own right and outside of the context of BPD. Nonetheless, the findings are somewhat inconsistent and raise the issue of to what extent self-harm can be considered a unique disorder. It is not clear if and how self-harm behaviour differs in those who would meet the criteria for self-harm disorder, those who would meet the criteria for BPD diagnosis, and those who report previous self-harm but do not fully meet either set of criteria. These results therefore need to be interpreted with caution, as the current criteria for self-harm as a stand-alone disorder is preliminary and requires more research to validate its inclusion in future versions of the DSM. It is also important to bear in mind that self-harm can be a significant problem outside of a meaningful clinical diagnosis, as many individuals who self-harm may not come to clinical attention because of the secrecy and shame often associated with self-harm (Hawton & James, 2005). Consequently, they are considered a difficult group to engage in research (Hawton & Sinclair, 2003; Clarke et al., 2004).

2.4 Treatment and Prognosis of Self-harm

Some researchers consider self-harm as a symptom that should be managed, as opposed to an illness or disorder that should be treated (Skegg, 2005). Consequently, treatment typically focuses on the underlying problems that precipitate self-harm (e.g., BPD, psychosis). In contrast, other researchers have argued that self-harm is a disorder in its own right, and should be treated as such (e.g., APA, 2013; Pattison and Kahan, 1983; see section 2.3 for a fuller discussion).

A Cochrane Review (Hawton et al., 1998; 1999) compared randomised controlled trials of either psychosocial or physical treatments for patients self-harm, but found there was insufficient evidence to make a firm recommendation on the most appropriate treatment. Dialectical behaviour therapy reduced repetition of self-harm in individuals with BPD, and flupenthixol (a tricyclic antidepressant) depot injections were also shown to reduce repetition of self-harm compared to a placebo. Both of these studies suffered from low statistical power and 'repetition of self-harm' was not consistently defined or measured in a standardised way, therefore the results need to be interpreted with caution. Effective treatments for self-harm are greatly needed, but the evidence-base for such treatments remains scarce. Large scale longitudinal studies are needed in order to provide more definitive evidence for the various treatments, and how they influence the prognosis of self-harm behaviours (Skegg, 2005).

2.5 Clinical Importance of Self-harm

Self-harm behaviours that cause damage to body tissue (e.g., cutting, burning) pose a risk of serious infection and permanent scarring (Wraight et al., 2008). More severe types of self-harm (e.g., asphyxiation, self-poisoning) can result in accidental and premature death (Jacobson, Muehlenkamp, Miller & Turner, 2008). Furthermore, little is known about the prognosis of self-harm and although effective treatments for self-harm are greatly needed, there is currently insufficient evidence to make a firm recommendation on the most appropriate treatment (Hawton et al., 1998; 1999). Given the high prevalence rate of self-harm in both clinical and non-clinical populations (Briere & Gil, 1998), and the fact that it is a major risk factor for suicide (Owens et al., 2002), it is somewhat surprising that self-harm is still poorly understood (Skegg, 2005). Most of the research on self-harm has focused on

emotion related factors to the neglect of other relevant mechanisms such as neurocognitive factors (Dixon-Gordon, Gratz, McDermott & Tull, 2014). There is an urgent need to understand the aetiology and development of self-harm behaviour in order to reduce the risk is poses. The recent inclusion of NSSI disorder as a 'condition for further study' in the DSM-5 further reinforces the clinical importance of the behaviour.

Chapter 3 Borderline Personality Disorder

3.1 Clinical Features of BPD

Borderline personality disorder (BPD) is characterised by fear of abandonment, instability in affect regulation, self-image, and interpersonal relationships, self-harm, and difficulty with controlling impulsive behaviours (APA, 2013). The DSM-5 states that individuals with BPD can have profound changes in self-image, affect, cognition and behaviour when they perceive (whether real or imagined) separation and rejection. They are described as being "sensitive to environmental circumstances" (APA, 2013, p. 663) and experience intense abandonment fears and inappropriate anger when faced with separation, which can lead to an intolerance of being alone. Often as a reaction to these feelings of abandonment, individuals with BPD will perform impulsive acts such as self-harm or suicide attempts.

Self-harm is a crucial component of BPD, it was a diagnostic criterion of the disorder in the DSM-IV, and is described in the DSM-5 under the 'impulsivity' dimension as 'self-harming behaviour under emotional distress'. The DSM-5 emphasises self-harm less than its predecessor does, possibly because self-harm without suicidal intent is now included as a stand-alone condition for further study (APA, 2013). Up to 90% of BPD patients report multiple episodes of self-harm, and 72% of individuals with BPD reported using multiple methods of self-harm (Zanarini et al., 2008). It is important to note that individuals affected with BPD report a wide range of other dysregulated and self-damaging behaviours, such as drug abuse and disordered eating (Lieb et al., 2004), which suggests that self-harm is just one component in a pattern of impulsive and dysregulated behaviours. Self-harm shares other similarities in both BPD and non-BPD populations, for example it is not typically

driven by suicidal intent (Whitlock et al., 2006), and is considered distinct from suicidality, which is also a diagnostic criterion for BPD. Self-harm is most often conceptualised as an affect regulation mechanism, as overwhelmingly individuals with BPD reported engaging in self-harm to reduce unwanted negative feelings (Brown et al., 2002; Gratz, 2003; Klonsky, 2007), however it is likely that self-harm can serve multiple functions including self-punishment, or as an anti-dissociation mechanism (APA, 2000; Klonsky, 2007).

Intense inner emotional pain is a core attribute of BPD (Bradley, Conklin, & Westen, 2005; Holme & Severinsson, 2008; 2010) and the maladaptive way in which individuals regulate and express this pain (Zanarini & Frankenburg, 2007) is believed to underlie many of its behaviours, particularly self-harm (Linehan, 1993). Unwillingness or inability to tolerate this negative emotional distress prompts the individuals to escape or avoid said distress, often by self-injurious behaviour (Korner et al., 2007; Linehan, 1993). This is consistent with Linehan's (1993) theory in which individuals with BPD have low levels of distress tolerance, and react with greater sensitivity and intensity to negative emotions.

3.2 Current Definitions and Diagnosis of BPD

The DSM-5 defines a 'Personality disorder' (PD) as an "enduring pattern of inner experience and behaviour that deviates markedly from the expectations of the individual's culture, is pervasive and inflexible, has an onset in adolescence or early adulthood, is stable over time, and leads to distress or impairment" (APA, 2013, p. 645). Initially, personality disorders are presented in section II of the manual simply with an update of the text from the previous version. This can be contrasted with the 'alternative' model for BPD presented in section III of the DSM-5, which characterises PDs by impairments in personality functioning (relating to self and

interpersonal), and pathological personality traits. It is argued that the strength of the alternative multidimensional model for PDs lies in its sensitivity, as it allows clinicians to assess multiple areas of personality variation, rather than focusing on traits or behaviours that fit into a particular diagnostic category.

Personality functioning refers to elements relating to the self (self-identity and self-direction) and others (empathy and intimacy). Impairment in these areas can be rated on the Level of Personality Functioning Scale, which is included in the DSM-5 (ranging from Level 0: healthy, adaptive functioning, to Level 4: extreme impairment). It is suggested that a 'moderate' level of impairment in functioning is required for a PD diagnosis, and this can be identified by serious disturbances in identity (e.g., vulnerable self-esteem), self-direction (e.g., unreasonable high or low standards), empathy, and intimacy (e.g., unrealistic expectations of relationships). The pathological personality traits were developed from a review of existing trait models of personality, and are organised into five broad domains: Negative Affectivity, Detachment, Antagonism, Disinhibition, and Psychoticism. The five domains are further broken down into 25 trait facets. A full description of each of the 25 facets is beyond the scope of this thesis, but a brief summary is presented in Table 3.1.

Table 3.1 DSM-5 Personality Trait Domains and Facets

Domain (polar opposites)	Facets
Negative Affectivity (vs. Emotional Stability)	Emotional lability, anxiousness, separation insecurity, submissiveness, hostility, perseveration, depressivity, suspiciousness, restricted affectivity (lack of).
Detachment (vs. Extraversion)	Withdrawal, intimacy avoidance, anhedonia, depressivity, suspiciousness, restricted affectivity.
Antagonism (vs. Agreeableness)	Manipulativeness, deceitfulness, grandiosity, attention seeking, callousness.
Disinhibition (vs. conscientiousness)	Irresponsibility, impulsivity, distractibility, risk taking, rigid perfectionism (lack of).
Psychoticism (vs. lucidity)	Unusual beliefs and experiences, eccentricity, cognitive and perceptual dysregulation (odd or unusual thought processes).

3.3 Epidemiology and Aetiology of BPD

3.3.1 Epidemiology.

BPD is generally thought to affect 1% - 2% of the general population (Crowell, Beauchaine, & Linehan, 2009; Torgersen, Kringlen, & Cramer, 2001). In clinical populations, BPD is thought to affect 10 - 20% of psychiatric patients (Lieb et al., 2004). BPD has a high mortality rate with up to 10% of patients committing suicide, a rate almost 50 times that of the general population (Lieb et al., 2004). Most of the individuals diagnosed with BPD are female (Widiger & Weissman, 1991), yet contemporary epidemiologic studies suggest that prevalence rates are generally similar between genders (Grant et al., 2008; Jonhson et al., 2003; Torgersen et al., 2001). Men and women diagnosed with BPD appear to share more similarities than they have differences in relation to number and severity of symptoms (Johnson et al., 2003).

The main gender difference seen in BPD is the expression of impulsivity; women are more likely to display internalising behaviours, which can manifest as

eating disorders, along with mood, anxiety, and/or posttraumatic stress disorders (Sansone & Sansone, 2011). Conversely, men with BPD are more likely to express their impulsivity as externalising behaviours, such as substance abuse or physical aggression towards others (Johnson et al., 2003). As men are more likely to externalise their behaviour in an aggressive or antisocial way, this has led to some researchers proposing that BPD and antisocial personality disorder (ASPD) are actually sex-moderated manifestations of a single underlying pathology (Beauchaine, Klein, Crowell, Derbidge, & Gatzke-Kopp, 2009; Paris, 1997). ASPD and BPD have the same range of prevalence in the community, but the sex distribution for ASPD is 80% male and for BPD 80% female (Paris, 1997), additionally ASPD and BPD are highly comorbid in clinical samples (Becker, Grilo, Edaell, & McGlashan, 2002).

Both BPD and ASPD are substantially linked to impulsivity and aggressiveness, but BPD was predicted by 'emotional' or 'feeling' aggressive whereas ASPD was predicted by physical aggression, oppositional behaviour, and indirect aggression (Fossati et al., 2004). This suggests that ASPD and BPD may share a common aetiology (Paris, 1997; Beauchaine et al., 2009), but that there may be a differential vulnerability to externalised aggression in men, versus internalised aggression in women. Sansone and Sansone (2011) argue that because men and women with BPD tend to exhibit slightly different behaviours and presentations, men are more likely to use drug/alcohol rehabilitation services than women are, and less likely to use pharmacotherapy and psychotherapy services. Therefore, women typically present in a mental health setting for treatment, whereas men are more likely to present in prison settings. This suggests a sampling bias with regard to prevalence studies, and may explain why men with BPD appear to be under-represented in mental health settings.

Symptoms of BPD typically begin to emerge during adolescence, and even though they bear a strong resemblance to the BPD diagnosis in adults (Bradley et al., 2005), there is a reluctance to diagnose BPD in adolescence due to the notion that personality traits are not stable until adulthood (Stepp, 2012). Indeed, the DSM-IV (APA, 2000) stated that individuals must have reached adulthood before a diagnosis of a personality disorder can be made. Consequently, there is little research that examines how BPD features change in the period between adolescence and early adulthood. A longitudinal twin study by Bornolova and colleagues (2009) found that BPD features peak (number of symptoms and severity) between the ages of 14 - 17 and remain relatively stable, but begin to decline significantly into adulthood. These findings are supported by Lenzenweger (1999), who also found that the mean level of BPD features decreased from adolescence to adulthood, but that the rank-order stability is high. In middle to late adulthood, evidence suggests that BPD features continue to decline (Zanarini, Frankenburg, Hennen & Silk, 2003), with one study reporting that the greatest decline occurring after 44 years of age (Grant et al., 2008). This means that although BPD features may generally decline in intensity and severity over time within the population (mean level), they remain relatively stable within the individual (rank-order stability), suggesting that BPD features are enduring and consistent characteristics.

3.3.2 Aetiology.

An early review on the aetiology of BPD (Zanarini and Frankenburg, 1997) concluded that there are multiple pathways to developing BPD. Generally the factors which appear to have aetiological significance for the development of BPD can be split into environmental factors such as childhood trauma, and more inherent factors such as genetics, temperament, and neurobiological dysfunction. Genetic

studies of BPD are relatively scarce (Distel et al., 2009), but estimates suggest that around 40% of the variation in BPD features is explained by additive genetic influences (Distel et al., 2008). There could also be a neurobiological basis to the aetiology of BPD; which is discussed in more detail in section 4.2.

Environmental aetiological factors that may contribute to BPD include early childhood trauma (Ball & Links, 2009) and caregiver neglect (Sabo, 1997), as both are commonly reported by individuals with BPD. Both physical and sexual abuse in childhood is commonly reported by BPD patients, with sexual abuse consistently reported more often by BPD patients than by individuals who are depressed or personality disordered (PD) controls (Zanarini & Frankenburg, 1997). Ball and Links argue that there is sufficient evidence to support a causal relationship between childhood trauma and BPD features; however this is a questionable assertion as not all individual diagnosed with BPD report childhood sexual abuse, and not all individuals who have been sexually abused develop significant BPD symptoms (Landbecker, 1992). Moreover, a meta-analysis by Fossati and colleagues (1999) found only a small association between childhood sexual abuse and later development of BPD, and did not find childhood sexual abuse to be a major risk-factor or causal antecedent to BPD. Therefore, the relationship between BPD and childhood sexual abuse may not be as strong as initially presumed.

It may not necessarily be sexual abuse but negative childhood experiences more generally that contribute to the aetiology of BPD. Young's (2000) schema theory of psychopathology theorises that experiencing a childhood in which basic needs are not met leads to the development of early maladaptive schemas. Schemas are rigid cognitive structures of deeply entrenched, dysfunctional belief systems that evolve as a product of the child's attempts to make sense of his or her

experience. Maladaptive schemas are problematic because schema-specific information is highly prioritised and difficult to inhibit, resulting in negative biases in early information processing (Beck, Freeman & Davis, 2006). Early maladaptive schemas have been assessed or treated in patients with a range of axis I disorders (Nordahl & Nysæter, 2005) and it is theorised that they also play a role in personality disorders.

Young (2000) argues that particular combinations of early maladaptive schemas result in the development and maintenance of specific personality disorder symptoms. Broadly speaking, individuals with BPD appear to have a wide range of maladaptive schemas, but they have specific schemas relating to disconnection and defectiveness (Nordahl & Nysæter, 2005), and it has been suggested that there may be an abandonment schema unique to BPD (Reeves & Taylor, 2007). More specifically, research has shown that individuals with BPD appear to process information through a specific set of schemas that relate to themselves and others which are: "I am powerless and vulnerable", "I am inherently unacceptable" and "Others are dangerous and malevolent" (Sieswerda, Arntz, Mertens & Vertommen, 2007). Young's schema theory attempts to explain BPD pathology as an underlying borderline personality structure characterised by dysfunctional schemas that become activated in a rapid and cycling manner (Kellog & Young, 2006).

Perhaps the most influential model of BPD is Linehan's (1993) biosocial theory. Within this model, early biological vulnerabilities such as impulsivity and heightened emotional sensitivity become exacerbated by environmental influences (particularly an invalidating environment) throughout the lifespan. The reciprocal relationship between biological vulnerabilities and environmental risk factors lead to the broad emotion regulation difficulties, which are core problems in BPD (Crowell et

al., 2009). Linehan proposes that the emotional regulation difficulties in BPD are made up of several components: heightened emotional sensitivity, inability to regulate intense emotional responses, and a slow return to emotional baseline. Additionally, individuals with BPD are relatively unable to tolerate the high levels of distress and negative affect and so are likely to engage in maladaptive strategies (e.g., self-harm) during emotionally challenging situations (Crowell et al., 2009)

A recent review of the literature by Carpenter and Trull (2013) found evidence to support each of these components in BPD. They found that individuals with BPD do appear to experience heightened levels of both emotion sensitivity and negative affect, and suggest that this is possibly due to the presence of a negative bias in identifying and evaluating emotion in themselves and others. In addition, low distress tolerance coupled with a lack of appropriate affect regulation strategies but a surplus of maladaptive strategies makes them vulnerable to dysregulated behaviour. Linehan's (1993) theory is also supported by neuropsychological research (Ayduk et al., 2008; LeGris & van Reekum, 2006; also see section 4.2) which has demonstrated that emotion dysregulation in BPD may indeed have a biological basis.

The attachment-based models of BPD (e.g., Meyer & Pilkonis, 2005) conceptualise the problem behaviours in BPD as the outcome of poor or impaired attachment organisation. Given that one of the criterion for a BPD diagnosis is 'frantic efforts to avoid real or imagined abandonment' (APA, 2013), this in essence reconceptualises BPD as a disorder of attachment anxiety (Meyer & Pilkonis, 2005). Based on the early work of Bowlby (1969; 1973), the quality of interactions between a child and its primary caregiver leads to the child building 'internal working models' of themselves and others. These internal working models are mental structures (schemas) that guide the child's knowledge and expectations of future relationships,

based on their previous attachment experiences. Internal working models are conceived as playing a role in the processing of attachment-relevant social information (Dykas & Cassidy, 2011), because individuals are likely to use different (i.e., biased) rules to process attachment-relevant information as a function of whether they have a secure or an insecure internal working model of attachment.

Given that a central part of Bowlby's (1969; 1973) theory is that early interactions with caregivers form a critical context for later emotion regulation processes, several researchers have described the attachment system as an emotion regulation device (e.g., Schore, 1994; 2003a; 2003b; Shaver & Mikulincer, 2007). According to Shaver and Mikulincer (2007), secure attachment facilitates emotion regulation strategies that are aimed at relieving distress and fostering comfortable and supportive relationships, such as support seeking and problem focused coping strategies. In avoidant attachment, emotion regulation strategies are aimed at suppressing or blocking negative emotions by deactivation of the attachment system. In contrast, anxiously attached individuals are more likely to employ affect regulation strategies aimed at attracting attention from caregivers, which results in chronic hyperactivation of the attachment system. The idea that attachment experiences are central to emotion regulation is further supported by neuropsychological research from Schore (1993; 2003a; 2003b). In Schore's model, attachment is a biological control mechanism that regulates affective driven behaviour. Early regulation of emotion is thought to evolve initially from a dyadic management of emotion between caregiver and infant, but becomes increasingly self-regulated as a result of neurophysiological development. This implicates the role of early interactions on later emotion regulation abilities.

Attachment experiences can therefore influence personality development via these internal working models. In BPD, it is argued that the core symptoms such as emotion dysregulation, intense and unstable interpersonal relationships, fear of abandonment, rage/anger, and a lack of a sense of self, stems from insecurity in the underlying attachment organisation (Levy, 2005). A review of the literature by Agrawal and colleagues (2004) concluded that there was a strong association between BPD and insecure forms of attachment, and in particular with unresolved, fearful, and preoccupied attachment styles. Individuals with these attachment styles long for intimacy whilst simultaneously are concerned about dependency and rejection. These insecure attachment patterns seen in BPD patients may exacerbate certain problematic emotions, for example the fear of abandonment could be triggered in an interpersonal context, or what Holmes (2004) terms as an 'attachment crisis'. Indeed, interpersonal difficulties were most related to depressive symptoms in individuals with high BPD features (Cheavens, Strunk & Chriki, 2012) (For a fuller discussion of attachment in BPD and self-harm, see section 5.3).

The psychodynamic - based theories of BPD (e.g., Clarkin, Lenzenweger, Yeomans, Levy & Kernberg, 2007) also draw on attachment theory and internal working models of the self and others, but primarily focus on how these can affect the sense of self. A defining criterion of BPD is the lack of a coherent and stable sense of self, therefore psychodynamic theorists argue that this particular pathology represents a lack of integration among positive and negative self and other representations. This 'identity diffusion' manifests in the typical constellation of BPD features such as emotional instability, anger, interpersonal chaos and impulsive and self-destructive behaviours. There is relatively little research to support the psychodynamic conceptualisation of BPD over other models. For example, a study

by Cheavens and colleagues (2012) found that emotion dysregulation and interpersonal difficulties were both stronger predictors of BPD features than 'sense of self', suggesting that it may be of lesser importance in its contribution to problematic symptoms.

To summarise, biological and psychosocial pathways to BPD are complex, and although there are competing theoretical models that attempt to explain the aetiology and maintenance of BPD, no model integrates all the data (Fonagy, & Bateman, 2008). The various theoretical models differ by the importance placed on certain characteristics or symptoms of the disorder. For example, Linehan's biosocial model (1993) emphasises emotion regulation difficulties as being central to BPD. In contrast, attachment-based theories of BPD emphasise problematic interpersonal relationships, and psychodynamic-based theories focuses on the lack of a sense of self (Cheavens, Strunk & Chriki, 2012). A comparison of the biosocial, attachment, and psychodynamic theories by Cheavens and colleagues (2012) found that difficulties in emotion regulation were stronger predictors of BPD features, initially supporting Linehan's biosocial model. However, interpersonal difficulties were most related to depressive symptoms in individuals with high BPD features, demonstrating some support for the attachment based models (e.g., Meyer & Pilkonis, 2005). The authors suggest that emotion regulation may play a larger role in chronic forms of the disorder, while interpersonal problems may be associated with the more acute symptoms of BPD. This is again consistent with the findings from treatment of BPD patients by Livesley (2007; 2012) and Zanarini et al., (2003) who suggest that impulsive symptoms represent an acute phase whilst affective symptoms are more enduring and more difficult to treat.

3.4 Treatment and Prognosis of BPD

Remissions in BPD are common; in one study almost three quarters of BPD patients that had a remission of symptoms over the course of a six year period, only 5.9% experienced a significant recurrence of symptoms (Zanarini et al., 2003). The severity of dysphoric states appears to decline significantly over time in BPD, regardless of whether the individual is considered recovered (Reed, Fitzmaurice, & Zanarini, 2012). The affective symptoms are the least likely to resolve, whilst impulsive symptoms such as suicide ideation and self-harm are most likely to improve (Zanarini et al., 2003). Zanarini and colleagues suggest that this may be because impulsive symptoms (e.g., self-harm, suicide efforts, quasi-psychotic thought, treatment regression) are a manifestation of acute illness, whereas the affective symptoms are core features of BPD and so are relatively resistant to change. Self-harm can therefore be an important marker of an acute crisis and represent a need for immediate treatment or hospitalisation, particularly in those individuals considered to have recovered from BPD.

The National Institute for Health and Clinical Excellence (NICE) published guidelines (2009) for the treatment and management of BPD in the UK, and these guidelines are frequently adopted in many other countries as they are based closely on empirical evidence (Levy, Yeomans, Denning & Fertuck, 2010) and use a systematic and unbiased methodology in reaching its conclusions (Tyrer & Haigh, 2010). NICE do not recommend any drug treatment specifically for BPD or for symptoms or behaviours directly associated with the disorder, with the aim of reducing unnecessary drug treatment. The NICE guidelines specifically rule out the use of anti-psychotic drugs, but do recommend that drug treatment may be used for co-morbid conditions (such as depression or anxiety) as part of an overall treatment

plan, as well as recommending the use of sedatives during crisis if necessary. However, a meta-analysis by Olabi and Hall (2010) found that a wide range of pharmacological treatments are commonly used in BPD despite the limited evidence of efficacy. They found that anti-psychotics were widely prescribed for BPD, as they are believed to be effective at improving impulsivity, aggression, and quasi-psychotic symptoms (e.g., dissociation). The evidence for the effectiveness of anti-psychotics is tentative at best (Kolla, Eisenberg, & Links, 2008), given that the risks and side effects involved with anti-psychotic medication are considerable, and the benefits appear comparatively small (Tyrer & Haigh, 2010).

The only psychotherapeutic treatment recommended by NICE as an effective treatment for BPD is Dialectical Behaviour Therapy (DBT). DBT is a cognitive based behavioural therapy developed by Linehan (1993) and is designed to treat complex and difficult mental disorders such as BPD and persistent suicidal behaviour. It is based around the concepts of acceptance and change, and focuses on building and improving skills that BPD patients may lack, such as the skill to negotiate interpersonal relationships, self and emotion regulation, and distress tolerance (Dimeff & Linehan, 2001). An early study comparing DBT with treatment-as-usual showed that DBT appears to reduce self-harm, and limit patient dropout (Linehan, Armstrong, Suarez, Allmon & Heard, 1991). Furthermore, contemporary studies have also found DBT to be effective at reducing self-harm behaviours (Low, Jones, Duggan, Power & MacLeod, 2001; Neacsiu, Rizvi & Linehan, 2010).

The NICE guidelines have been criticised for recommending DBT over other psychotherapeutic treatments. There are other empirically based promising treatments available such as mentalization-based therapy (MBT), schema-focused therapy, system training for emotional predictability and problem solving (STEPP),

transference-focused psychotherapy (TFP), and cognitive-behavioural therapies (CBT), that have been specifically developed for BPD patients (Levy et al., 2010). Paris (2010) argues that whilst any well-structured therapy will perform better than treatment-as-usual, no particular psychotherapy has yet emerged as being clearly superior. In addition, advocating DBT over and above other therapies does not take in to account the heterogeneity of BPD features. Given this heterogeneity, some clinicians may wish to take a more individualistic and eclectic approach to treating patients with BPD which is tailored to their specific needs, but this would mean practicing outside of the NICE guidelines (Reich, 2010).

Some researchers, notably Livesley (2007; 2012), strongly support eclecticism in treatment of BPD. Livesley argues that outcomes are generally similar across efficacious BPD treatments, and so no one treatment can be considered superior. In addition, given the heterogeneity of BPD, no current treatment is comprehensive enough to provide the range of methods needed to treat all manifestations of the disorder. Furthermore, adherence to a single treatment may prevent therapists from taking the unique characteristics of patients into account. Consequently, Livesley argues that it is necessary to move beyond a "competing schools or therapies" approach, and adopt an evidence-based approach that integrates effective methods from all therapies.

This integrative approach to treatment combines treatment principles and methods that work regardless of their conceptual origins (Livesley, 2007; 2012). Paris (2015) identified that the two main elements from efficacious BPD therapies were increasing interpersonal skills, and affect regulation skills such as regulating and stabilising emotional responses, and mindfulness. The treatments differed on the amount of therapist burden (e.g., being available by telephone/email or pager in

DBT), and attention given to childhood issues. For example, childhood experiences are generally not focussed on in Cognitive Behaviour Therapy (CBT) unlike the psychodynamic approaches, whereas some therapies like DBT take a middle ground approach. Similarly, Beatson and Rao (2014) argued that all the empirically supported treatments for BPD essentially develop security of attachment and the ability to reflect on (or be mindful of) the mental states of the self and others, in an attachment context, thus increasing affect regulation and interpersonal skills.

Livesley (2002; 2012) also argues that treatment could essentially be divided into phases, ranging from short-term crisis interventions, medium-term treatment that increases emotion and impulse regulation and decreases self-harming behaviour, and long-term treatment lasting several years that is intended to change interpersonal patterns and promote more integrated personality functioning. This is consistent with the findings of Zanarini et al. (2003), who argued impulsive symptoms represent an acute illness phase, whereas affective symptoms are more enduring. Similarly, Beatson and Rao (2014) concluded that individual psychotherapy should be the principal treatment for BPD, because effective treatment requires an eclectic approach that incorporates different psychotherapeutic techniques according to individual patient needs.

3.5 Clinical Importance of BPD

BPD evidently causes severe suffering due to intense dysphoric affect, mood reactivity, and disturbed self-image. Individuals with BPD engage in a number of self-damaging behaviours such as drug abuse and high frequency self-harm, and are at increased risk of suicide (Lieb et al., 2004). In addition, due to the pervasive nature of the disorder, BPD patients are high treatment users compared to other psychiatric groups (Bender et al., 2006). Compared to Axis II controls, individuals

with BPD entered treatment at a younger age, spent more time in therapy, reported more hospitalisations, and took medication for longer (Zanarini, Frankenburg, Khera, & Bleichmar, 2001). The high frequency use of mental health services in BPD raises concerns about the adequacy of the treatment, and suggests more needs to be learned about the underlying aetiological factors of BPD in order to target treatments more effectively.

Individuals with BPD also suffer from impaired global and psychosocial functioning in domains such as education, occupation, and generally have poorer health outcomes. Adolescents diagnosed with BPD had the most severe psychiatric symptoms and functional impairment (across a number of domains) compared to those with other personality disorders, and those with no personality disorder (Chanen, Jovez & Jackson, 2007). In addition, BPD was also linked with higher lifetime rates of sexually transmitted diseases and medical problems. This pattern on functional impairment is also seen in adults; Skodol et al. (2002) found that patients with BPD (along with schizotypal personality disorder) had greater impairment on virtually every measure of global and psychosocial functioning, including marriage, education, and occupation. Even if functioning increases over time because of symptom remittance, individuals with BPD are still likely to be significantly more impaired than that of other Axis II patients (Zanarini, Frankenburg, Hennen, Reich, & Silk, 2004).

Even though remission of symptoms in BPD is common (Zanarini et al., 2003), psychosocial functioning can be impaired in the long term (Gunderson et al., 2011). Gunderson and colleagues found that over a 10 year follow-up period, patients with BPD showed some improvement in psychosocial functioning, but it was less clinically significant than improvements in other areas of psychopathology.

Additionally, overall level of employment in the BPD sample remained consistently and significantly poorer than for those with other personality disorders or major depressive disorder (MDD). Similarly, a study by Skodol and colleagues (2002) found that patients who had a diagnosis of schizotypal or borderline personality disorder had greater impairment on virtually every measure of functional impairment than patients with obsessive-compulsive personality disorder or MDD. This suggests that psychosocial functioning in BPD can be severely and persistently impaired over a long period of time.

Studies have generally shown BPD to be highly comorbid with a range of other psychopathological disorders including substance use, mood, anxiety, other personality disorders, and PTSD (Grant et al., 2008; Zanarini et al., 1998). Having a diagnosis of BPD can complicate the course and prognosis of any co-morbid disorders. For example, comorbid diagnoses BPD and MDD were associated with an increased number of suicide attempts (Soloff, Lynch, Kelly, Malone, & Mann, 2000).

Additionally, patients with the two disorders took a significantly longer time to attain remission from MDD, than did patients with MDD but without comorbid BPD (Grilo et al., 2005). Research has shown that Individuals with comorbid PTSD and BPD have significantly greater burden of illness than individuals with either disorder alone, including more symptoms, poorer health and quality of life, increased odds of suicide attempts, and higher rates of comorbidity with other Axis I conditions. Furthermore, patients with BPD can continue to suffer from episodes of Axis I disorders over a long period, with remission from these disorders being strongly influenced by BPD remission status (Zanarini et al., 2004). Specifically, in patients whose BPD symptoms remitted the percentage who met criteria for different axis I disorders

decreased over time. In contrast, in those whose BPD symptoms did not remit, co-morbid axis I disorders remained constant over time.

It is clear that further research is needed to understand the underlying aetiology of BPD, in order to lead to more effective avenues of practice and treatment, and to reduce both the patients suffering and the burden on mental health and forensic services. Self-harm both as a core feature of BPD and as a unique behaviour in its own right requires more research because the aetiology and prognosis is poorly understood. The choice of BPD and self-harm as the focus of this series of studies was guided by the strong relationship between the two constructs, clinical importance and possible shared deficits in neurobiological mechanisms (e.g., executive functions) (LeGris & Van Reekum, 2006). Therefore, the next section focuses on executive functions as potential mediators or moderators of the relationship between self-harm and BPD features, as executive functions may partly provide a useful theoretical framework for understanding the aetiology and maintenance self-harm behaviours and BPD features.

Chapter 4 Executive Functions

4.1 A Brief Overview of Executive Functions

Executive function(s) (EFs) refer to a range of metacognitive capacities (higher-order attentional and control processes) that co-ordinate/maintain, initiate or inhibit other cognitive and emotional processes (Miyake et al., 2000; Barker et al., 2010; Morton and Barker, 2010). EFs are associated with frontal brain networks, which are essential for goal-directed behaviours, including planning, temporal sequencing, and goal attainment (Shallice and Burgess, 1991; Miyake et al., 2000; Royall et al., 2002; Barker et al., 2010; Morton and Barker, 2010). Executive dysfunction (previously 'dysexecutive syndrome'; Baddeley & Wilson, 1988) is commonly seen after traumatic brain injury (TBI), and can result in deficits in reasoning, planning, concept formation, mental flexibility, aspects of attention and awareness, and purposeful behaviour (McDonald, Flashman, & Saykin, 2002). Executive dysfunction caused by TBI can be persistent, (Hartikainen et al., 2010), therefore adversely affecting employment prospects and relationship status (Barker et al., 2010).

Contemporary studies of patients with frontal lobe lesions have observed that they have difficulty selecting appropriate behavioural actions (Stuss & Benson, 1986), and difficulty initiating, modifying, and inhibiting behaviour in the face of changing stimuli (D'Esposito & Gazzaley, 2005). They also exhibit problems with sustained and selective attention and self-awareness (Mateer, 2000). Because of this historical association between EFs and frontal lobe functions, they are often discussed synonymously. As one researcher notes: "It is virtually impossible to find a discussion of prefrontal lobe lesions that does not make reference to disturbances of executive functions and, in parallel fashion, there is rarely a discussion of

disturbances of executive functions that does not make reference to dysfunction in prefrontal brain regions" (Tranel, Andersen & Benton, 1994, p. 126).

However, a systematic meta-analysis of lesion and neuroimaging studies by Alvarez and Emory (2006) revealed inconsistent support for this historical association between EFs and the frontal lobes. They argue against the circularity of linking anatomy (frontal lobes) with a neuropsychological construct (executive functions), and instead proposed that EFs are a collection of multiple processes that require intact frontal and non-frontal brain regions for optimum executive pathways. This is echoed by other researchers who argue that EFs can be compromised without any evidence of frontal lobe lesions or abnormalities (Royall et al., 2002), and that EFs represent only one functional category within the frontal lobes (Stuss, 2011). Consequently, as the relationship between EFs and the frontal lobes is not entirely clear, it is suggested that researchers separate anatomy from function (Baddeley & Della Sala, 1996).

This is further supported by Royall et al. (2002) who argue that EFs do not map reliably into specific brain regions of interest, and instead suggests that EFs rely on the integrity of various distributed networks of cortical regions. Bigler and Maxwell (2012) echo this, and argue that structural abnormalities revealed by neuroimaging studies are only gross indicators reflecting underlying trauma-induced pathology. For example, in the case of TBI patients, the location and extent of their injury generally does not fully explain the extent of a patient's cognitive problems (Bigler, 2001). One explanation for this is that high-level cognitive functions, such as memory and EFs, depend on widely distributed brain networks connected by key pathways of long white matter tracts (Kinnunen et al, 2010). Therefore, any

disruption in these key pathways of white matter is likely to be reflected in cognitive impairment.

Kinnunen et al. (2010) argues that contemporary lesion and neuroimaging studies have largely ignored the importance of brain connectivity in cognitive processes, and have therefore underestimated the importance of white matter disruption in cognitive impairment. Using Diffusion Tensor Imaging (DTI) techniques, a comparison of patients with TBI and age-matched controls revealed that the majority of the white matter showed some evidence of disruption in the traumatic brain injury group, therefore demonstrating that damage to brain connectivity pathways is a critical factor in the development of cognitive impairment after traumatic brain injury (Kinnunen et al., 2010). DTI has been used to track brain fibres (tractography) and reconstruct the 3D trajectories of white matter tracts in the brain. Certain domains of cognitive functioning, in particular executive functioning and memory appear differentially sensitive to alterations in white matter (Gunning-Dixon & Raz, 2000). Research has shown that EF processes are dependent on the integrity of the white matter tracts that facilitate transmission of data among different brain regions (Caeyenberghs et al., 2014; Kim et al., 2014; Kinnunen et al., 2010; Royall et al., 2002). It has been suggested that executive functions depend on interactions in neural networks involving the frontal cortex, basal ganglia, and thalamus (Frank, Scheres, & Sherman, 2007; Leunissen et al., 2014).

Having discussed the possible underlying brain regions and pathways, associated with executive functioning, this section of the thesis addresses conceptual models of EFs. There are a variety of conceptual models that attempt to capture and define executive functions, and they can broadly be separated into unitary theories, which propose a distinct executive system that monitors and directs

lower order cognitive processes; and theories that propose no such overarching construct exists, but that EFs are fractionated and emerge from monitoring processes and maintaining task rules and goals (D'Esposito & Gazzaley, 2005).

One of the first conceptual models of executive functions was the unitary 'central executive', proposed as a subcomponent of the working memory (WM) model by Baddeley and Hitch (1974). In this model, the central executive is responsible for overall control and distribution of limited attentional resources, and co-ordinating information from the visuo-spatial sketchpad (which processes spatial and visual information) and the phonological loop (which processes speech-based information). The working memory model was updated by Baddeley (2000) to include the Episodic Buffer, a limited-capacity temporary storage system that is capable of integrating information from a variety of sources including the visuo-spatial sketchpad, phonological loop, and the long-term memory. The reasoning for introducing the episodic buffer was to account for phenomena that cannot be explained by the original model, for example amnesiacs who have little or no ability to encode new information in long-term memory, had good short-term recall of stories, recalling much more information than could be held in the phonological loop alone (Baddeley & Wilson, 2002). More recently, the episodic buffer has also been linked to perception and may be involved in binding visual features into perceptual objects (Baddeley, 2012).

The visuo-spatial sketchpad and phonological loop components have limited capacity and resources, therefore the Working Memory model predicts that any task that requires simultaneous operation of the visuo-spatial sketchpad and phonological loop will results in competition for resources and place extra load on the central executive. Therefore, using a dual-task methodology that engages both the visuo-

spatial sketchpad and phonological loop should adversely affect performance on the task, allowing observation and measurement of executive functions. Consequently, individuals with compromised executive function should (and do) display further impairment on the tasks than shown by a sample of generally healthy controls (Baddeley & Della Salla 1996; Feng, Pratt, & Spence, 2012; Rao & Baddeley 2013).

The central executive is conceptually similar to the Supervisory Attentional System (SAS) originally proposed by Norman and Shallice (1986), which is a framework of attentional control of executive functioning. The SAS specifies how schemas become activated (or suppressed) in routine situations or in novel situations. In routine situations (e.g., familiar or well-learned situations), the initiation or suppression of schemas is controlled by contention scheduling, whereas in unique, novel situations, the SAS takes control of cognitive processes.

Burgess and Shallice (1996a; 1996b; Shallice & Burgess, 1996) refined the original model by suggesting that the SAS can actually be fractionated into different sub processes ('executive functions') such as working memory, monitoring, rejecting, and generating schemas, goal setting, and episodic memory. Spontaneous schema generation is considered to be crucial in coping with novel situations and tasks, the SAS 'kicks in' to generate new and temporary schemas (as there are no existing schemas for the contention scheduling system to activate) in order to control the lower level schemas that are necessary to complete a novel task (Shallice, 2002). By fractionating the SAS in this way, it extends the explanatory power of the model by taking into account the wide range of cognitive deficits seen in frontal lobe damage (Banfield, Wyland, Macrae, Munte, & Heatherton, 2004).

Contemporary theories, such as that of Miyake and colleagues (2000), conceptualised EFs in a multi-componential model. They chose the three most

commonly researched EFs (shifting, updating, and inhibition) and performed a confirmatory factor analysis performance on scores for a number of EF tasks using a student sample. Shifting refers to the ability to shift attention between mental sets (for example, during a dual-task), and it requires disengagement from irrelevant stimuli in order to focus on relevant stimuli and is linked to the anterior cingulate cortex (ACC) region of the brain. Updating refers to updating working memory; it involves maintaining and manipulating information in working memory, and is strongly linked to the dorsolateral prefrontal cortex (DLPFC). Inhibition refers to suppressing/inhibiting of dominant or automatic responses (such as during the Stroop task). The results confirmed that the three EFs moderately correlated with each other, but were clearly separable processes. The authors point out that these are not the only executive functions, but that these are basic separable processes that probably underlie more complex EFs.

Similarly, Lezak and colleagues (2004) conceptualised EFs as a set of complex functions that are the basis of many cognitive, social, and emotional skills. According to this model, processes that contribute to EFs are volition, planning, purposive action, and effective performance. Lezak et al., (2004) define Volition as the capacity for intentional action in order to satisfy wants and needs; Planning refers to organising and sequencing behaviours in order to achieve a goal and requires sustained and selective attention; Purposive Action is the ability to change planned behaviour, such as in the face of a novel task and requires the ability to initiate, maintain, switch, and inhibit behaviours; and Effective Performance which is the ability to monitor and correct performance when necessary. Because this model is multi-componential, EFs can break down at any stage in behaviour that is planned and intentional (Lezak et al., 2004), which is why deficits in EFs manifest as a

constellation of difficulties, and why they are sensitive to damage in a variety of brain areas, and not just the frontal pathways.

Several theories posit a central role of attention to executive function (Anderson, 2003; Daches, Mor, Winquist, & Gilboa-Schechtman, 2010; Derryberry & Reed, 2002; Giesbrecht, Merckelbach, Geraerts & Sweets, 2004; Jurado & Rosselli, 2007; Muscara, Catroppa & Anderson, 2008; Spada, Georgiou & Wells, 2010; Stuss, 2011; Stuss & Alexander, 2000; 2007). One example of an executive attentional control model is that of Posner and Peterson (1990). They initially proposed three distinct attentional networks: Alerting (which is similar to sustained attention), Orienting (similar to selective attention), and Executive Control (the ability to resolve conflict between competing responses). Although this model is unusual in that it emphasises attention more than some other models of EFs, it corresponds well with Miyake et al.'s (2000) categorisation of executive functions, as importantly the concepts of executive control, including orientating to, switching, focussing, and/or inhibiting attention and other cognitive processes, is integral to each theory (Derryberry and Reed, 2002; Miyake et al., 2000; Posner and Peterson, 1990).

So far, EFs have been discussed strictly in the cognitive sense ('cold' cognitive processing; Schaefer et al., 2003), but the ability to monitor and change behaviour (self-regulation) is important across a wide range of social and emotional situations (Gyurak et al., 2012a). Self-regulation in this sense is an umbrella term that refers to goal directed behaviours, such as achievement (Hoffman, Schmeichel, & Baddeley, 2012) and emotion regulation (Gyurak et al., 2012). Successful self-regulation requires at least some of the components of the executive functions, such as planning, shifting and maintaining attention to move towards goals, and inhibition of unhelpful behaviours and cognitions. Social and personality psychology

researchers have studied the construct of self-regulation, and only now are the two theoretical concepts of self-regulation and executive functions beginning to come together (Rueda, Posner & Rothbart, 2005). The concept of 'effortful/executive control' (EC) has emerged from this literature as an important component of self-regulation and refers to the ability to shift and focus attention, error detection, planning and inhibitory control (Rothbart & Bates, 2006).

EC ability appears to play an important role in emotion driven processing ('hot' cognitive behaviours; Schaefer et al., 2003). A series of studies by Gyurak and colleagues (2009; 2012a) demonstrated that a number of established measures of EF (working memory, Stroop, Trails task, verbal fluency) were related to emotion regulation ability, but verbal-fluency performance was the component most strongly related as it consistently predicted emotion regulation ability across a range of stimuli (e.g., startle response, film clips) and emotions (e.g., disgust, amusement). Higher verbal fluency performance was related to more successful regulation of emotional responses (Gyurak et al., 2012a). The finding that among the EF measures, verbal fluency was the strongest predictor of emotion regulation underscores the fact that measures of EF are not interchangeable, but that they capture clinically, functionally and anatomically different aspects of EF (Gyurak et al., 2009; 2012a; Miyake et al., 2000; Royall et al., 2002). Although it is not clear why verbal fluency appears to be the strongest predictor of emotion regulation ability in Gyurak's studies (2009; 2012a), verbal fluency is considered to be a measure of cognitive flexibility (Delis, Kaplan, & Kramer, 2001), which is considered central to executive functioning (Gyurak et al., 2012a).

It is not surprising that EFs play a role in emotional regulation, as both the anterior cingulate cortex (ACC) and dorsolateral prefrontal cortex (DLPFC) region of

the brain appear to be part of a circuit or pathway that serves to regulate both cognitive *and* emotional processes (Bush, Luu, & Posner, 2000; Miyake et al., 2000). A Functional Magnetic Imaging (fMRI) study by Ochsner and colleagues (2002) aimed to identify underlying neural pathways of emotional control found that cognitive reappraisal of emotional stimuli resulted in higher prefrontal cortex (PFC) activation than when reappraising neutral stimuli. The activation in the PFC was highly correlated with amygdala activation, which is an important area for emotion processing (Nunes et al., 2009). As pathways within the PFC region are also implicated in EFs (MacDonald, Cohen, Stenger, & Carter, 2000; Yamasaki, LaBar, & McCarthy, 2002), this again suggests that overlapping prefrontal and limbic pathways are involved in both cognitive and emotional control.

Taken together, the research discussed in this section supports the conceptualisation of EFs as a multi-componential model of clearly separable processes, that co-ordinate/maintain, initiate or inhibit other cognitive and emotional processes (Miyake et al., 2000; Barker et al., 2010; Morton and Barker, 2010). EF processes have historically been linked to the frontal lobes (e.g., Luria, 1966), but contemporary research suggests that EFs probably rely on a complex interaction of neural pathways that communicate across many different brain regions (Caeyenberghs et al., 2014; Kim, et al, 2014.; Kinnunen et al., 2010; Royall et al., 2002). It is relatively well established that EFs play a crucial role in 'cold' (non-emotional and controlled) cognitive processes, but research now suggests that they may be of equal importance in 'hot' (emotional) processing (Bush, Luu, & Posner, 2000; Miyake et al,, 2000; Ochsner et al., 2002). Emotion regulation appears to rely at least partly on EFs (Blair & Ursache, 2011; Gyurak et al., 2009; 2012a),

consequently the role of EFs in emotion processing and regulation is discussed in further detail in the next section, specifically in relation to BPD and self-harm.

4.2 Neuropsychological functioning in self-harm

The previous section demonstrated the importance of the integrity of the EFs in both cognitive and emotional processes, so therefore it is not surprising that impairments in executive functioning have been linked to a variety of psychopathological conditions including attention deficit hyperactivity disorder (ADHD) (Barkley & Murphy, 2010), post-traumatic stress disorder (PTSD) (Aupperle, Melrose, Stein & Paulus, 2012), schizophrenia (Eisenberg & Berman, 2010), major depressive disorder (Snyder, 2013) and personality disorders (Coolidge, Thede & Jang, 2004). This section examines the evidence for EF deficits in relation to self-harm behaviour and BPD, respectively.

There are few studies that have looked at the neuropsychological functioning that underpins self-harm behaviour, and even fewer still that have looked at the role of EFs specifically; those that have are generally inconsistent in their findings. Oldershaw et al. (2009) found no significant group differences in decision making on the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio & Lee, 1999) in adolescents who previously or currently self-harmed, compared to depressed or healthy controls. However, when they separated out participants who currently self-harmed from those who had previously self-harmed (but did not do so currently), the current self-harm group exhibited impaired decision-making abilities. Therefore, impaired decision-making appeared to have a direct relationship with recency of self-harm episodes. Although it is not clear if abilities of the past self-harm group had impaired decision-making abilities when their self-harm behaviour was present, or

whether the current self-harm group consisted of subtly different, or more severe cases.

Similarly, a study by Andover and colleagues (2011) using a variety of measures of executive functioning (attention, motor functioning, and memory) reported finding no significant differences in neuropsychological functioning among groups of prisoners who reported histories of self-harm, those who reported suicide (but not self-harm), or those with no history of either. They did find significant EF impairment across all groups, and "alarmingly prevalent" (p.1110) levels of self-harm, but given that both EF impairment (Meijers, Harte, Jonker & Meynen, 2015; Tuominen et al., 2014) and self-harm appears to be common in a prison population (Smith & Kaminski, 2010; 2011; Dixon-Gordon et al., 2012), it is difficult to know to what extent they are related.

A study by Dixon-Gordon and colleagues (2014) found deficits in executive attention as measured by performance on the Attention Network Task (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002) among individuals with recent repeated self-harm, relative to participants who reported no history of self-harm. Allen and Hooley (2014) using the Stop-Signal Task (SST) (Verbruggen and Logan, 2008) as a measure of behavioural inhibition, found that self-harming participants showed poorer inhibition to images depicting negative emotional content compared to healthy controls. However, the self-harm group appeared to exhibit enhanced inhibition to positive or self-harm related content, compared to the controls. Allen and Hooley suggest that this could be due to participants' positive emotional response to images or images of cutting, possibly because they do not find them aversive, or are habituated to such imagery. The results from Dixon-Gordon et al. and Allen and Hooley provide preliminary support for an association between EF deficits and self-

harm, but it is a much neglected area of research, and so future research examining the role of EFs in the development and maintenance of self-harm behaviour is urgently needed.

4.2.1 Executive functions in BPD

Unlike self-harm, the study of executive function performance in individuals with BPD has been a fruitful area of research; 86% of studies reviewed showed some degree of impairment in EFs in BPD (LeGris & van Reekum, 2006). Ayduk et al. (2008) concluded that the only neuropsychological domain that was consistently impaired in BPD individuals were executive functions, in particular inhibition of impulsive acts. A rare study by Mathiesen and colleagues (2014) compared individuals diagnosed with BPD to brain injured patients who met the criteria for organic personality disorder (OPD), which refers to personality change due to another medical condition (APA, 2013), across a series of neurocognitive tests. BPD and OPD patients displayed similar executive deficits such as visual-motor skills, design fluency, attention, abstraction, and problem solving. Somewhat surprisingly, the BPD group performed worse on measures of verbal intelligence and learning, verbal fluency, and auditory attention, which means they had more severe language, attention, and verbal memory deficits compared to the brain injury group. This further supports the notion that BPD features are, at least in part, a product of impaired neurocognitive systems, particularly EFs.

The EF deficits in BPD and self-harm discussed in the previous sections could be explained by a dysfunctional frontolimbic network implicated in regulatory control processes, including the hippocampus, and amygdala (Krause-Utz, Winter, Niedtfeld, & Schmahl, 2014; Schmahl & Bremner, 2006; Silbersweig et al., 2007; Wingenfeld et al., 2009) anterior cingulate cortex (ACC), orbitofrontal cortex (OFC)

dorsolateral prefrontal cortex (DLPFC). The findings from structural and metabolic studies show several abnormalities in these brain regions in BPD individuals compared to controls.

There is evidence to suggest abnormal amygdala structure in BPD, a meta-analysis by Nunes et al. (2009) raised the possibility that reduced amygdala and hippocampal volume may be a biological substrate for some of the symptoms in BPD. The amygdala is a complex brain structure that forms part of the limbic system, which is thought to play a central role in emotional processing and reactivity (Nunes et al., 2009). Located in the temporal lobe, the amygdala appears to be involved in a wide range of behavioural and emotional functions ranging from normal to pathological (LeDoux, 2007). Figure 4.1 shows the anatomical location of the amygdala (in red). The amygdala is anatomically close to the hippocampus in the brain, and together they are considered the key brain region where emotions meet memory (Phelps, 2004). The anatomical location of the hippocampus can be seen in Figure 4.2. The hippocampus is important in memory formation (Moser & Moser, 1998), as well as playing a role in attentional monitoring of emotional states (Soloff, Nutche, Goradia & Diwadkar, 2008).

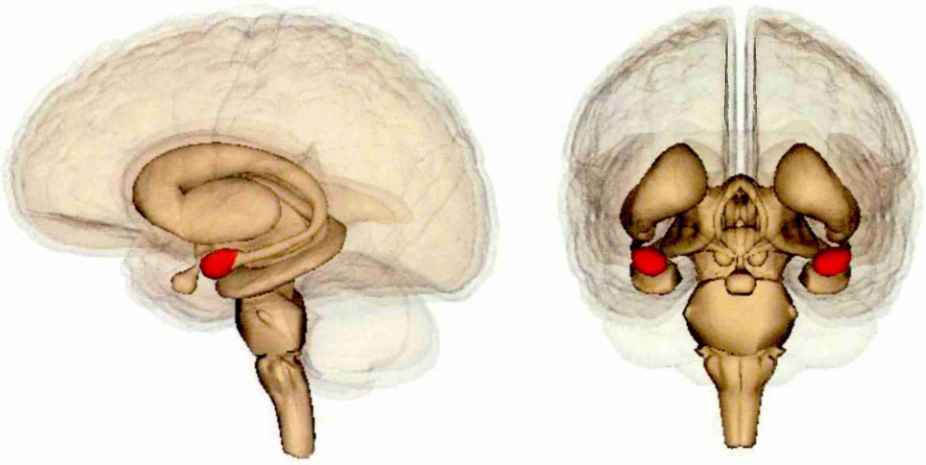

Figure 4.1 Anatomical location of the amygdala (in red) from the left view (left) and anterior view (right) (Mitsuhashi, 2009).

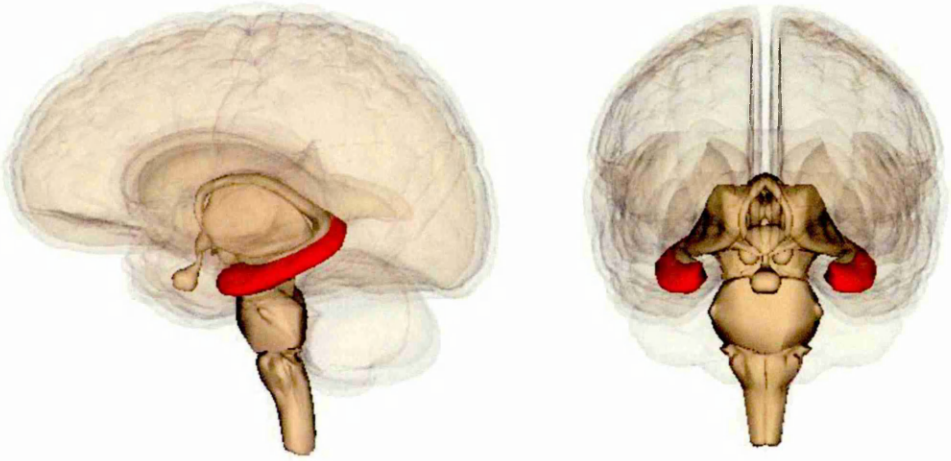

Figure 4.2 Anatomical location of the hippocampus (in red) from the left view (left) and anterior view (right). Both images reproduced under a Creative Commons licence from "BodyParts3D: 3D structure database for anatomical concepts" by N. Mitsuhashi et al, 2009, *Nucleic Acids Research*, *37*(suppl 1), D782-D785. Copyright 2009 – 2015 by Database Center for Life Science.

Both the amygdala and hippocampus are important components in regulating cognitive and emotional processes (Costafreda, Brammar, David & Fu, 2007; Gallagher & Chiba, 1996; LeDoux, 2007). The findings from structural studies of in the amygdala in BPD are inconsistent, research has found between a 7% (Driessen et al., 2000) to 25% (Tebartz van Elst et al., 2007) bilateral reduction of the amygdala in BPD patients compared to controls, however other studies have found no difference (Chanen et al., 2007; Zetsche et al., 2006).

Metabolism in the amygdala may also be abnormal, but again the evidence is somewhat inconsistent. A study by Hoerst et al. (2010a) found significantly reduced metabolism in the left amygdala in BPD patients. Conversely, a similar study by Salavert et al. (2011) found no statistical differences in metabolic function in the amygdala between groups of BPD and healthy controls. A relatively unique functional MRI (fMRI) study by Niedtfeld et al. (2010) presented participants with affective stimuli in the form of facial pictures and found that both negative and neutral faces led to stronger activation in the amygdala of BPD patients compared to healthy controls. The authors suggest that these results may indicate hyperactivity of the amygdala (as part of a hyperactive frontolimbic network) in response to emotional stimuli in BPD.

The hippocampus is one of the brain regions that show consistent alterations in structure in BPD (Schmahl & Bremner, 2006). Driessen et al. (2000) found that individuals with BPD had up to 16% reduced hippocampal volume compared to healthy controls. Other studies have generally shown support for reduced hippocampal volume in patients with BPD features (Sala et al., 2011; Soloff et al., 2008; Tebartz van Elst et al., 2003; Zetzsche et al., 2006). Metabolic studies have generally shown reduced metabolism in the left hippocampus in individuals with BPD

compared to healthy controls (Juengling et al., 2003; Salavert et al., 2011), suggesting both structural and functional abnormalities in this area may be present in BPD.

The prefrontal cortex (PFC) area of the brain is a heterogeneous region that is implicated in cognitive flexibility and control (MacDonald et al., 2000; Yamasaki et al., 2002). Figure 4.3 shows a sagittal view of the prefrontal cortex of the brain with the cortical regions delineated (dorsolateral, DLPFC; and prefrontal, PFC). Compared to controls, individuals with BPD generally have reduced volume in pre-frontal brain regions (e.g. Brunner et al, 2010; Chanen et al., 2008; Tebartz van Elst et al., 2003), however the findings are not entirely consistent as other studies have not shown clear and consistent differences in the PFC (Sala et al., 2010; Tebartz van Elst et al., 2003). DTI studies have generally shown structural connectivity deficits in white matter tracts in the PFC (e.g. Grant, 2007; New et al., 2013; Whalley et al., 2015) which suggest impaired connectivity between regions. It has been suggested that this compromised white matter structure in the frontal regions can result in poor emotional processing and regulation dysregulation, and poor impulse control that is seen in BPD and may underlie impulsive and aggressive behaviours, in particular self-harm.

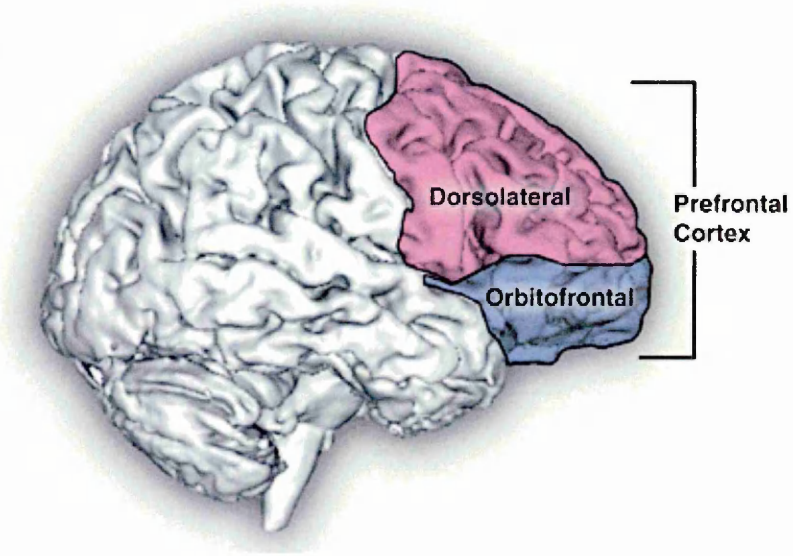

Figure 4.3 Sagittal view of the brain with the cortical regions delineated, image reproduced under a Creative Commons licence from "Translational studies of alcoholism: bridging the gap" by M. Zahr and E. Sullivan, 2008, *Alcohol research & health: the journal of the National Institute on Alcohol Abuse and Alcoholism, 31(3),* 215. Copyright 2008 by the National Institute on Alcohol Abuse & Alcoholism.

The anterior cingulate cortex (ACC) occupies a central anatomic location in the brain just behind the PFC and has important cortical and limbic connections (Margulies et al., 2007). Figure 4.4 shows the anatomical location of the anterior cingulate which is considered to serve numerous functions, including cognitive and emotional processing and regulation, pain processing, and visceral and basic skeletomotor activity (Margulies et al; Vogt, Finch, & Olson, 1992). Posner and colleagues (2007) consider the ACC to play a vital role in self-regulation, and in particular as part of the executive attentional network. Executive functions and emotional processing are both thought to be strongly related to ACC functioning (Vogt et al.).

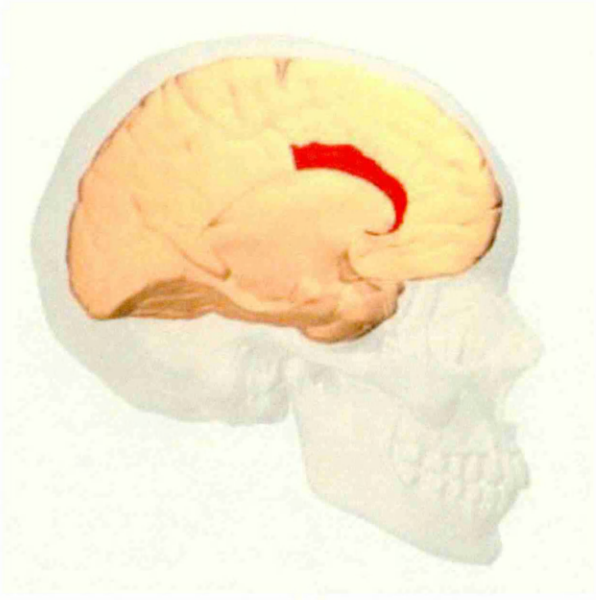

Figure 4.4 Medial view of the anterior cingulate gyrus (in red). Reproduced under a Creative Commons licence from "BodyParts3D: 3D structure database for anatomical concepts" by N. Mitsuhashi et al., 2009, *Nucleic Acids Research*, *37*(suppl 1), D782-D785. Copyright 2009 – 2015 by Database Center for Life Science.

Structural imaging studies have generally shown reduced volume in the ACC in BPD patients compared to controls (Hazlett et al, 2005; Tebartz van Elst et al, 2003; Whittle et al, 2009). Furthermore, this reduced volume was correlated with self-harm (Tebartz van Elst et al, 2003; Whittle et al, 2009), which suggests the ACC may play a role in self-harm, although this relationship is speculative. DTI studies of the ACC, although relatively rare, have shown impaired connectivity between both hemispheres of the ACC in BPD when compared to controls (Rüsch et al, 2010). However, it is important to bear in mind that the ACC has been shown to have high morphometric variability generally (Whittle et al, 2009), so differences in volume should be treated with caution. Metabolic studies on the ACC generally show increased metabolism in the ACC in individuals with BPD compared to healthy

controls (Hoerst et al., 2010b; Juengling et al., 2003; Salavert et al., 2011), whilst fMRI studies of the ACC have generally found reduced activity in BPD compared to controls (Ruocco, Amirthavasagam, Choi-Kain, & McMain, 2013; Silbersweig et al., 2007; Wingenfeld et al., 2008). These differences likely manifests as impairments in inhibitory mechanisms, possibly underlying impulsive behaviour in BPD (van Zutphen, Siep, Jacob, Goebel, & Arntz, 2015).

4.2.1.1 Evaluation of imaging studies.

The neuroimaging methods described could be considered to be in relative infancy, and therefore have a number of limitations. There is considerable heterogeneity of the methods used, for example more contemporary MRI studies have moved towards an increase in magnetic field strength to produce higher resolution and faster images, with some studies using 7 Tesla (a unit of magnetic field strength) compared to lower (3 or 4 Tesla) magnetic fields in older studies. Research suggests that differing field strength may not adversely affect reliability of measurements (Han et al., 2006), but given that there is such a wide variety of imaging machines and software used across studies, caution is warranted when comparing across studies.

Since fMRI scans do not produce a 'photograph' of the brain in the same way an x-ray machine does, complex and sophisticated signal processing is necessary just to obtain the images. 'Activity' reported by neuroimaging studies do not refer to neuronal activity per se, but compares the proportion of deoxygenated haemoglobin relative to oxygenated haemoglobin, which is generally considered a correlate of neural activity (Beck, 2010). Measures of blood oxygenation level dependant (BOLD) signals can be problematic in themselves, the stability and reliability of BOLD signals is not currently fully understood, but research suggests that BOLD

measures computed at the voxel level will not often have a test-retest reliability of above .7 (Vul, Harris, Winkielman, & Pashler, 2009). In addition, the Kolmogorov-Smirnov (KS) statistic, which is a common and widely used statistic to test hypotheses regarding BOLD levels, can increase false positive results (Aguirre, Zarahn, & D'Esposito, 1998).

Perhaps because there is no true consensus on analysis and interpretation of imaging data (Aguirre et al., 1998), statistical errors or misreporting may occur in up to 50% of neuroimaging studies (Nieuwenhuis, Forstmann, & Wagenmakers, 2011). For example, Nieuwenhuis and colleagues found that when comparing two conditions, researchers tend to report the significance of each condition, rather than the significance between the *difference* of the two conditions. In addition, multiple tests of significance are also common in neuroscience research, the more voxels that are tested the more family wise error rates (FWE) increase. The Bonferonni correction that is typically used for multiple comparisons does not account for image smoothness, and therefore is seen as not appropriate for imaging studies due to being overly conservative, and so are generally not used (Kriegeskorte, Lindquist, Nichols, Poldrack, & Vul, 2010).

In addition, imaging studies tend to be expensive (Bandettini, 2009) with time on imaging machines at a premium; consequently such studies tend to have low sample sizes (generally 12-24 participants). This results in low statistical power, which not only reduces the chance of detecting a true effect, but also reduces the likelihood that a statistically significant result reflects a true effect (Button et al., 2013). This reduces reliability of the findings and makes replication difficult, and has led to ethically related criticisms of imaging studies with low power, arguing that they are both inefficient and wasteful (Button et al., 2013).

Often the brain abnormalities found are not specific to any one diagnosis. For example, abnormal glutamate concentrations in the frontal lobes is associated with a wide range of psychiatric illnesses (Hoerst et al., 2010b), and structural changes in the amygdala are associated with a wide range of psychiatric conditions, especially those involving fear and anxiety to some extent (e.g., BPD, PTSD, phobias, panic disorder) (LeDoux, 2007). Decety and Cacioppo (2010) advocate the use of neuroimaging methods as a powerful tool for studying brain functions, but argue that such evidence needs to be combined with appropriate conceptual analyses in order to make beneficial progress. This approach is often referred to as the 'golden triangle' of human neuroscience research, and represents the equal importance of physiological methods (such as fMRI), experimental research (e.g., lesion studies), and behavioural evidence (e.g., response times or experimental tasks). Although all three methodological approaches have their respective limitations, combined they can provide a richer understanding of the brain-behaviour relationships.

4.3 Summary and Conclusions

There is limited research into the neuropsychological functioning that underpins self-harm, but it has been suggested that EF deficits such as impaired decision-making and poor inhibition may play a role. Research with BPD patients support these findings, indicating that impulsivity and risky behaviours, core symptoms of BPD, may reflect difficulties with initiating, modifying, and inhibiting behaviour. In addition, poor decision making may also contribute to the recurrent self-harm and suicidal behaviour. Reduced executive functions leave an individual vulnerable to act on dominant tendencies, even if maladaptive (Spada et al., 2009); in the case of individuals with BPD, this may be self-harm.

These EF deficits seen in BPD may occur as a result of a dysfunctional frontolimbic network including the anterior cingulate cortex (ACC), orbitofrontal cortex (OFC) dorsolateral prefrontal cortex (DLPFC), hippocampus, and amygdala, which are heavily implicated in BPD symptomology (Schmahl & Bremner, 2006). However, the precise relationship between the frontolimbic network and BPD symptoms, including self-harm is far from clear, and as suggested by Decety and Cacioppo (2010) research from other methodologies, such as behavioural evidence, needs to be considered. In addition, it is unclear whether executive dysfunction is a predisposing factor for difficulties in emotion regulation, or is a consequence.

Chapter 5 Attachment Theory

5.1 Development of Attachment Theory

Attachment theory originates from the work of Bowlby (1969; 1973) stemming from his interest in the link between maternal loss and deprivation, and later psychological maladjustment. Combining theories from fields of psychoanalysis, evolutionary biology, and ethology, Bowlby (e.g., 1969; 1973) proposed that attachment is a survival mechanism that functions by bonding the infant to the primary caregiver (historically, this is usually the mother), and vice versa. In infants, attachment behaviour generally takes the form of proximity seeking to a caregiver in situations of (perceived or real) distress and can take the form of crying (if in distress), clinging, or following. In later childhood (6 months – 2 years of age), children use their attachment figure as a *secure base* from which they can explore and safely return to.

The response of the caregiver to these attachment behaviours influences the development of 'internal working models', which will guide the child's expectation about future relationships. For example, a caregiver that is available and responsive in times of stress facilitates development of a secure base, or what Sroufe and Waters (1977) called 'felt security'. Having a sense of felt security leads to less proximity seeking behaviours in the absence of a threat, and increased exploration of the situation or environment. When distressed (by a threat or separation,) the child is quickly comforted by contact with the caregiver and returns to a sense of felt security (Sroufe & Waters). Therefore, the child will likely develop an internal working model of attachment security, as they are secure in the knowledge that they have a secure base to return to in times of need, and feel confident to cope with the same problem in the future.

However, if the caregiver is repeatedly unavailable, is not sensitive to the needs of the child, or is inconsistent in their responses then less adaptive attachment patterns and internal working models will form. Therefore, the availability and responsiveness of the caregiver can influence the social and emotional development via internal working models, and different relationship experiences can lead to different developmental outcomes. This led to the development of the notion of 'attachment styles' or 'attachment patterns'. Ainsworth identified three qualitatively different attachment patterns in infants in response to the 'Strange Situation' paradigm (Ainsworth, Blehar, Waters, & Wall, 1978).

The 'Strange Situation' is a laboratory based situation designed to allow researchers to observe attachment and exploratory behaviour of infants in response to various unfamiliar situations: introduction into an unfamiliar environment, introduction of a stranger, separation from the mother, and subsequent reunion with the mother. Three major patterns of behaviour were observed: securely attached infants more readily explored, cried less upon separation, displayed proximity seeking behaviour upon reunion, and generally responded more positively and co-operatively to their mother. Infants who displayed anxious-ambivalent attachment patterns were more wary of the stranger, intensely upset by the separation, and ambivalent upon reunion. Infants who displayed anxious-avoidant attachment patterns maintained exploration of the environment, were not upset by separation, and avoided the mother upon reunion.

Ainsworth (1985) interpreted these attachment patterns as reflecting internal working models. Securely attached infants develop a working model of the mother as responsive and accessible, and will readily use her as a secure base from which to explore. The infant may become distressed during separation, but promptly seeks

comfort and contact upon reunion and is readily soothed. In contrast, anxious-ambivalent infants develop a working model of the mother as inconsistently accessible and responsive. They are led to expect frustration when displaying attachment behaviour, so their behaviour is often suffused with frustrated anger. Upon reunion the child is ambivalent, both wanting contact and yet being angry, so they are often difficult to soothe. Anxious-avoidant infants develop a working model of the mother as being likely to reject contact. They therefore experience a severe approach-avoidance conflict; they simultaneously desire close contact with the mother, but feel angry because they expect rejection. This has often been conceptualised as a defence mechanism, as by deactivating the attachment system the child avoids further distress and anger.

Further studies have also identified another type of insecure attachment referred to as disorganized/disoriented (Main & Solomon, 1990), these infants exhibit a diverse and contradictory pattern of behaviours such as complete absence of an attachment strategy, freezing in the presence of the caregiver, dissociation, and apprehension. Disorganised patterns of attachment in infancy have been strongly linked to difficulties in school, aggression, and psychopathology in later years (Green & Goldwyn, 2000; Main, 1996).

5.2 Adult Attachment

Although attachment theory has historically been discussed in relation to infant-caregiver interactions, recent research has looked at attachment in adulthood, in the context of adult romantic relationships. Meyer and Pilkonis (2001) define adult attachment styles as describing people's comfort and confidence in close relationships, fear of rejection, desire for intimacy, and preference for self-sufficiency or interpersonal distance. Adult attachment styles represent internal working models

(mental representations) of others, the self in relation to others, and of relationships in general.

Hazan and Shaver (1987) were among the first researchers to apply the principles of attachment theory to adult relationships, conceptualising romantic love as an attachment process, experienced differently by individuals due to variations in their attachment histories. Using Ainsworth's (1985) attachment pattern categorisations of secure, anxious-ambivalent, and anxious-avoidant, they conducted a series of studies using adults. Hazan and Shaver observed that the frequencies of the attachment patterns were similar in adulthood to those observed in childhood, with 56% of adults being securely attached, 24% were anxious-avoidant, and 20% were anxious-ambivalent.

Adults who were securely attached generally experienced romantic love as happy, friendly, trusting, accepting, and supportive and reported longer lasting relationships compared to adults with anxious attachment patterns. Adults who had anxious-avoidant attachment patterns experienced romantic love as being characterised by emotional highs and lows and an intense fear of intimacy, whereas adults with anxious-ambivalent attachment experienced love as being characterised by emotional highs and lows, obsessions, extreme sexual attraction and desire for union, and jealousy. Hazan and Shaver (1987) suggests that differences in adult attachment orientation represent differences in beliefs about romantic love, and the availability and trustworthiness of the self and partners.

Bartholomew and Horowitz (1991) conceptualised adult attachment as relating to two types of internal working models, an internal working model of the self and an internal working model of others. Each dimension can be dichotomised as positive or negative, e.g., the model of the self as worthy of love and support or not,

and the model of others as trustworthy and available vs. unreliable and rejecting. These two dichotomous dimensions yield four hypothetical attachment prototypes, as illustrated in Table 5.1.

Table 5.1 Bartholomew and Horowitz (1991) Conceptualisation of Internal Working Models of Self and Others.

		Internal working model of self	
		Positive	Negative
Internal working model of others	Positive	Secure	Preoccupied
	Negative	Dismissing/avoidant	Fearful Avoidant

Individuals with the secure attachment prototype generally have a positive image of the self and others; they have a sense of their own worthiness and lovability and experience others as generally responsive and accepting. The preoccupied attachment prototype has a negative view of the self, as unworthy and unlovable but a positive view of others as responsive and accepting. The preoccupied prototype corresponds well to the anxious-ambivalent pattern described by Hazan and Shaver (1987). The dismissing/avoidant prototype has a positive image of the self, but a negative view of others, whereas the fearful/avoidant prototype has a negative image of both the self and others. The dismissing/avoidant and fearful/avoidant prototypes partly correspond with the anxious-avoidant pattern described by Hazan and Shaver.

According to Hazan and Shaver (1987), internal working models of the self and others begin to develop in infancy, and continue to guide relationship behaviour throughout the lifespan. The theory therefore suggests that early caregiving experiences in infancy influence adult romantic relationship behaviour, at least in part. Consequently, it was thought that internal working models are highly resistant to change because they influence cognitions, and are therefore likely to assimilate relational information in a way that is consistent with previous expectations, even by

distorting the information to fit existing expectations rather than accommodate inconsistent information.

Later conceptualisations of adult attachment generally consider it to be made up of two fundamental dimensions of attachment-related anxiety and attachment-related avoidance (Brennan, Clark & Shaver, 1998; Fraley & Waller, 1998; Griffin & Bartholomew, 1994), which is illustrated in Figure 5.1. This is a multidimensional representation of Bartholomew and Horowitz's (1991) four category model, whereby working models of the self and others correspond to the anxiety and avoidance dimensions, respectively. Attachment-related anxiety corresponds to anxiety and vigilance concerning rejection and abandonment, individuals high in anxiety worry about the availability, responsiveness, and attentiveness of their partner, whereas those low on the anxiety dimension are more secure in their relationships. Attachment-related avoidance corresponds to discomfort with closeness, intimacy, and dependency. Individuals who score highly on the attachment-related avoidance dimension prefer not to rely or depend on others, whereas people on the low end of this dimension are more comfortable depending on others and having others rely upon them. A typically securely attached adult is low on both of these dimensions as they have positive internal working models of the self and others.

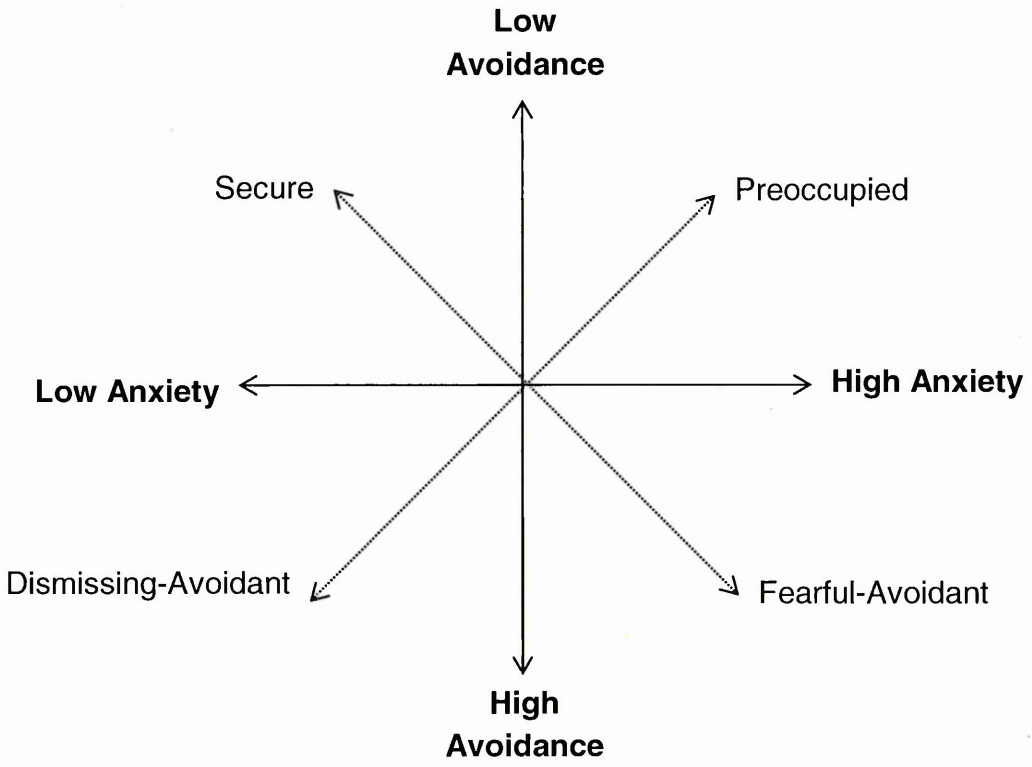

Figure 5.1 Conceptualisation of attachment as dimensions of attachment-related anxiety and attachment-related avoidance.

Early interactions with caregivers also influence the development of later emotion regulation processes (Brenning, Soenens, Braet, & Bosmans, 2012; Schore, 1994; 2003a; 2003b; Shaver & Mikulincer, 2007). Early negative attachment experiences can cause disruptions in the attachment system (Pearlman & Courtois, 2005), and are common in both BPD (Ball & Links, 2009; Sabo, 1997) and self-harm (Briere & Gil, 1998; van der Kolk, Perry, & Herman, 1991). Therefore it is not surprising that insecure attachment styles may play a role in the affect regulation difficulties that are central to both BPD features and self-harm (Linehan, 1993). Shaver and Mikulincer's (2007) attachment based affect regulation model proposes that secure attachment leads to security-based strategies of affect regulation (such

as support seeking and problem focused coping) which reduces negative affect. Anxious and avoidant attachment leads to hyperactivation and deactivation of the attachment system, respectively, heightening or suppressing the negative affect.

Those with anxious attachment employ emotion focused coping strategies aimed at eliciting attention from others, or eliciting a more reliable and consistent response. This leads to the attachment system being chronically activated and potentially heightening the negative emotions. In contrast, individuals with avoidant attachment use distance-focused strategies aimed at suppressing or distancing themselves from the negative affect, they effectively deactivate the attachment system by inhibiting or blocking negative affect, which has been caused by distant or rejecting attachment figures. Due to schematic processing of emotional stimuli (e.g., Young, 2000), persisting in seeing what one expects to see or influencing events so that they confirm expectations (interpretation and confirmation biases) can be a self-sustaining cycle (Mikulincer, Shaver, & Prereg, 2003).

That affect regulation strategies are strongly associated with the fundamental dimensions of attachment may explain how attachment relates to the onset and maintenance of psychopathology via affect regulation (Shaver & Mikulincer, 2007). Attachment insecurity and trauma also have been found to have a profound and severe impact on neurophysiological development (Schore, 1994; 2003a; 2003b, see also section 5.4). This may be particularly relevant for self-harm and BPD features given that early childhood trauma and affect dysregulation are common to both.

5.3 Attachment in Relation to Self-harm and Personality Disorders

Attachment insecurity is considered a possible aetiological factor for the development of psychopathology. Little is known about the role of attachment in self-harm behaviour, but individuals with secure attachment are more likely to use

adaptive emotion regulation strategies (e.g., behavioural or cognitive coping methods such as support seeking) (Schaffer, 1993). Whereas individuals with insecure attachments (e.g., to caregivers, peers, romantic partners) are more likely to use maladaptive affect regulation strategies such as self-harm (Suyemoto, 1998). A study looking at adult romantic attachment and self-harm found that romantic attachment characterized by high anxiety over abandonment influenced the prevalence of self-harm related thoughts (Levesque, Lafontaine, Bureau, Cloutier, & Dandurand, 2010). Both insecure attachment and self-harm are associated with the inability to manage anger and failure to self-regulate emotions (Suyemoto), and insecure attachment in childhood and adolescence can influence the development of negative internal working models of the self and others, and so may contribute further to the development of maladaptive emotion regulation strategies such as self-harm (Yates, 2004).

Studies have shown that the quality of caregiver – child relationships may be an important factor in the aetiology of self-harm behaviours; insecure attachment to a parental figure in childhood is significantly related to lifetime self-harm rates (Gratz, Conrad, & Roemer, 2002). Young adults who reported using self-harm described their childhood relationships with parents characterised by feelings of failed parental protection and parental abandonment. They also described their parents as being less caring, less trustful, and more difficult to communicate with (Bureau et al., 2010). This may create an invalidating environment for the child, which adversely affects the child's ability to self-regulate experiences of stress and anxiety, potentially leading to use of maladaptive coping strategies (Linehan, 1993).

More research has been conducted on attachment and self-harm in the context of BPD. Some argue that the fundamental aspects of BPD (including self-

harm) stem from impairments in the underlying attachment orientation (Levy, 2005). Particularly as the symptoms often occur in an interpersonal context and are precipitated by real or imagined events in relationships. One of the criteria for a BPD diagnosis is 'frantic efforts to avoid real or imagined abandonment' (APA, 2013), which in essence reflects a high level of attachment anxiety and ways in which individuals with BPD cope with the anxiety (Meyer & Pilkonis, 2005).

Using attachment organisation as a framework, BPD symptoms can be interpreted as expressions of underlying attachment insecurity. Meyer & Pilkonis (2005) argue that the intense, unpredictable, and often violent efforts to avoid abandonment and rejection (such as self-harm) suggest underlying incoherence and conflict in internal working models. This conflict occurs because attachment strategies are not targeted at one specific goal, but fluctuate between approach strategies (e.g., desire for greater intimacy) and avoidance strategies if intimacy is recognised as dangerous (e.g., high chance of rejection or abandonment). Individuals with BPD often oscillate between this approach/avoidance pattern, which suggests they have an underlying predominantly negative view of the self, but fluctuate between positive and negative views of others. This fluctuation results in the characteristic idealisation and devaluation of others so often seen in BPD.

BPD is associated with a primarily preoccupied style of attachment but may switch to a fearful style when views of others become negative (Meyer & Pilkonis, 2005). A review of BPD attachment studies by Agrawal et al. (2004) identified BPD patients as primarily being unresolved, preoccupied, and fearful in romantic relationships. In each of these attachment types, individuals demonstrate the approach/avoidance pattern of longing for intimacy, whilst simultaneously feeling anxious about dependency and rejection. It has been suggested that the

preoccupied attachment style is associated with experiences of unresolved trauma, possibly caused by the high rates of abuse reported by BPD patients, or by disturbances in parent-child relationships (Fonagy & Target, 1996).

Preoccupied attachment is defined as representing a negative model of self, combined with a positive model of others. Preoccupied individuals seek intimate relationships but are reactive to perceived dependency or undervaluation by others (Agrawal et al., 2004). Abuse in childhood necessarily results in a sense of the self as unworthy, undeserving, and bad (Alexander, 1992). Ready access to negative and confused affects and memories stemming from abuse reinforces the negative view of the self as excessively vulnerable and overly reliant on others. This can then lead to an idealised view of romantic partners, and inevitable disappointment and anger when the attachment figure fails to meet these idealistic expectations (Alexander).

Disturbances in the parent-child relationship have been strongly linked to mentalization ability. Mentalization is the term coined by Fonagy and colleagues (e.g., Fonagy & Target, 1996) to describe the process by which children acquire the capacity to interpret mental states (such as thoughts, feelings, and beliefs) of the self and others. The capacity for mentalization is dependent on the quality of interpersonal interactions, and therefore dependent on the emotional relationship between the infant and its caregivers. Fonagy and Bateman (2006) propose that attachment and mentalization are 'loosely coupled' concepts, underpinned by a common set of brain mechanisms activated by attachment triggers, in interpersonal contexts and intimate relationships.

Disruptions of the attachment system, and identity diffusion closely linked to such disruptions, are seen as the core features of BPD (Fonagy, Luyten &

Streathern, 2011). It has been argued that hyperactivity of the attachment system (a low threshold for activation under stress), along with low thresholds for deactivation of the capacity for mentalization, results in hypersensitivity to and increased susceptibility to contagion from other people's mental states. Consequently, individuals with BPD struggle to comprehend their internal mental states or the mental states of others, which leads to a cascade of impairments in other aspects of mentalization, such as affect regulation.

Within this mentalization framework, BPD functioning can be understood as the consequence of the loss of mentalization ability in emotionally intense relationship contexts (Fonagy & Luyten, 2009). This failure to mentalize can account for many of the core symptoms of BPD, including an unstable sense of self, impulsivity, and chronic feelings of emptiness (Fonagy et al., 2011). It is these difficulties that often result in individuals with BPD engaging in maladaptive affect regulation strategies such as self-harm or drug abuse. Mentalization based therapy (MBT) for BPD has been encouraging. Compared to treatment as usual (outpatient psychiatric treatment with occasional hospitalisations and regular medication), MBT has been shown to be effective up to five years after terminating therapy by reduction of suicide attempts, service use, symptom severity and increased global functioning (Bateman & Fonagy, 2008).

5.4 The Neuropsychology of Attachment

Schore (1994; 2003a; 2003b) used attachment theory as the basis for his 'Regulation theory', whereby attachment experiences in infancy shape the early organisation of the brain. Schore argues that in infancy, emotion is initially regulated by the caregiver, but becomes increasingly self-regulated as a result of neurophysiological development. In infancy, the primary caregiver attunes to the

infants' affective needs and responds appropriately and sensitively (affective synchronicity), for example soothing negative affect when the child is distressed or prolonging positive affect by attention and play. Attachment is not just re-establishing a secure base after distress or separation, but also involves interactive amplification of positive affect that creates a predictable safe base and positively charged curiosity in the infant to explore the environment.

The primary caregiver (usually the mother) therefore initially co-regulates the infants developing central and autonomic nervous system by attuning to the infants affective needs, and functions as the affect regulator in the short-term. Mistuning can occur, whereby the caregiver does not respond quickly or sensitively enough to the infants' needs, but as long as the caregiver is able to re-attune in a timely manner, then affect synchronicity can be maintained. In Schore's theory (1994; 2003a; 2003b), affect synchronicity is the building block of attachment and emotion regulation, and builds resiliency in the infant in the face of stress and novelty, therefore facilitating the development of secure attachment and self-regulation. If the attachment relationship is disrupted or chronically stressful for the infant, then this is the beginning of insecure attachment, right brain dysfunction, and a possible predisposition to later psychopathology.

By the end of first year, infants begin to regulate themselves via the maturation of internal regulatory mechanisms. Schore (2000) argues that affect synchronicity between the caregiver and infant directly influences the imprinting and wiring of the OFC, a corticolimbic area that begins maturation at around 12 months of age, and completes its critical period of growth between 18 – 24 months (see section 4.2 for discussion of the OFC and PFC). Specifically, he argues that attachment experiences shape the organisation of the right brain OFC, as the right

hemisphere matures before the left hemisphere at between 1 – 3 years of age (Chiron et al., 1997). This time frame matches Bowlby's maturation of the attachment system that is open to influence from the environment.

By the second year of age, the child begins to develop internal working models of the self and others, as a result of previous interactions with caregivers. Schore (1994; 2003a; 2003b) argues that these internal working models remain dominant throughout the lifespan, unconsciously influencing the reception, expression, communication of socioemotional stimuli which is vital for creating and maintaining interpersonal relationships. Attachment experiences therefore influence the early development and organisation of cortical and limbic areas of the right brain network, which are critical to self and emotion-regulation. Furthermore, attachment experiences also influence the developing infants' ability to cope adaptively with the socioemotional environment.

Schore (2001) presents a review of the evidence that supports the notion that attachment pathologies represent inefficient patterns of organisation in the right hemisphere of the brain, specifically in the OFC, and manifest in a limited capacity to modulate the intensity and duration of affect. Some have argued that affect dysregulation is a fundamental mechanism of all psychiatric disorders (Taylor, Bagby, & Parker, 1999), and this is particularly true of BPD (APA, 2013; Linehan, 1993). Furthermore, Schore argues that all attachment pathologies share common deficits in socioemotional information processing, due to limited capacity to perceive, decode, and interpret socioemotional stimuli. Therefore, attachment pathology will also manifest as social cognitive deficits.

To summarise, Schore's (e.g., 1994; 2003a; 2003b) regulation theory suggests the existence of an experience-dependant maturation of a regulatory

system associated with the orbitofrontal cortex area of the brain. In essence, attachment is the right brain regulation of affect synchronicity, which is the antecedent of self-control and self-regulation. Adaptive infant mental health is therefore an outcome of optimal attachment experiences that can be defined as the expression of efficient and resilient right brain strategies for regulation of positive and negative affect. Consequently, poor right brain capacity to process socioemotional stimuli can lead to maladaptive infant mental health, and is manifest in an inability to regulate affective states, and a fragile sense of the self (Schore, 2005).

Attachment is not exclusively a process seen in children, but has also been applied to adolescent and adult romantic relationships (e.g., Hazan & Shaver, 1987). Although there are few studies looking specifically at the neurobiology of attachment in adolescents (Escobar et al., 2013), it is known that adolescence represents a critical period of brain development for affective and social cognitive functions as the brain matures (Blakemore & Choudhury, 2006). Moretti and Peled (2004) consider adolescence is the "second major 'window' of opportunity and risk in development, next only in significance to early childhood development" (pp. 551). During adolescence, significant neuroanatomical changes occur in parts of the brain that are likely to affect cognition and behaviour, particularly the processes of synaptic pruning and myelination of the frontal cortex (Blakemore, 2008).

Several cortical regions, including the PFC undergo significant increases in white matter during adolescence, which is suggested to be due to protracted axonal myelination. Whereas in contrast, grey matter volume decreases, this is thought to reflect the synaptic pruning process. Initially, this process begins in the sensorimotor cortex, but spreads to the PFC in later adolescence (Blakemore, 2008). One possible explanation for these changes is that the brain is 'fine tuning' neural

connections for more efficient information processing (Blakemore, 2008). Naturally, the structural changes of these cortical regions may influence cognitive functioning during adolescence.

It appears that differing EF components show differing trajectories of development. For example, attention, working memory, and problem solving abilities improve during adolescence, and prospective memory continues to improve well into adulthood. In general terms, EF performance is at its peak after synaptic pruning, when efficient neural networks have been established (Choudhury, Blakemore, & Charman, 2006). Social cognition is also influenced by these brain changes, for example researchers have found that the ways in which adolescents think about others becomes more abstract, more differentiated and more multidimensional (Steinberg, 2005). One example of continuing social cognitive development during adolescence is the development of the ability to read emotion in faces and voices, and of proficiency in taking on others' emotional perspectives (Blakemore, 2008).

These changes in social and cognitive functioning occur around the same time that adolescents begin to assert more autonomous control over their decisions, emotions and actions, and start to disengage from parental control. At the same time, the school context involves an intense socialisation process during which adolescents become increasingly aware of the perspectives of classmates, teachers and other societal influences (Choudhury et al., 2006). The time spent with parents decreases and time spent with peers increases (Moretti & Peled, 2004).

There are few studies looking specifically at the neurobiology of attachment in adolescents (Escobar et al., 2013), but research suggests that attachment in adolescents exerts a similar effect as in childhood, by providing a secure base which encourages exploration and the development of cognitive, social and emotional

competences (Moretti & Peled, 2004). The frequency of attachment patterns seen in adolescent samples generally corresponds with the frequencies observed in both child and adult samples; however adolescent attachment behaviour is considered to be in transition, as the adolescent makes increased efforts to become less dependent on the primary caregiver (Allen & Land, 1999). Moretti and Peled describe this transition as an 'attachment dilemma', adolescents strive to maintain a relationship with their parents, whilst simultaneously exploring new social roles away from the family and developing new attachment relationships with peers and romantic partners.

Research shows that securely attached adolescents cope better with stress (Howard & Medway, 2004) compared to insecurely attached adolescents. Similarly, a study by Cooper, Shaver, and Collins (1998) found that securely attached adolescents have fewer psychopathological symptoms, more positive self-concepts (intellectual and social competence) and reported less risky/problem behaviours (such as drug use, sexual promiscuity, and educational underachievement). The results from Cooper et al. suggest that adolescents with different attachment types exhibit distinctive patterns of adjustment, and that these patterns are interpretable as characteristic styles of experiencing, expressing, and regulating negative emotions. Taken together, the evidence suggests that there is a compelling link between the quality of the parent-child and adolescent-child relationships, and cognitive development into adulthood.

5.5 Attachment and Social Cognition

The previous section discussed how attachment experiences could influence neuropsychological development, specifically development of the executive functions and social cognitive processes. Consequently, this section discusses how

attachment styles and internal working models may influence the development and maintenance of self-harm and BPD features, through social cognitive processes. Internal working models play a role in the processing of attachment-relevant social information (Dykas & Cassidy, 2011), as individuals are likely to use biased rules to process social information as a function of whether they have a secure or an insecure internal working model of attachment. Early researchers (e.g., Westen, 1991) suggested that internal working models of the self and others form early in life between a child and the caregiver, and that the emotions and expectations attached to these representations are critically important determinants for interpersonal functioning in later life. Viewed through the lens of attachment theory, secure attachment allows a child to develop and maintain a coherent and positive sense of self with positive expectations of others (Bowlby, 1973). Whilst in BPD, disturbed/insecure attachment results in incoherent and inconsistent negative self-other representations (Clarkin et al., 2007; Levy, 2005; Meyer & Pilkonis, 2005)

Self-other disturbances and interpersonal difficulties are crucial to BPD and are core features of the disorder (e.g., Clarkin, Yeomans & Kernberg, 2006; Fonagy & Bateman, 2008). Some researchers have suggested that social cognition (i.e., encoding, interpretation, and processing of information pertaining to other people) may be the proximate link by which attachment orientation exerts its effects on BPD features (Williams et al., 2015). There is strong evidence of social cognitive deficits in BPD; a review by Lazarus and colleagues (2014) found a wide range of social-cognitive domains are impaired compared to healthy controls. These deficits include more negative views of others, more negative expectations of relationships, impaired social problem solving skills, difficulty perceiving and identifying affect in facial

features, and greater negative stress reactions to social and interpersonal stressors (Lazarus et al., 2014).

Disturbed emotional processing in BPD is related to cognitive biases, whereby individuals distort interpretations and reactions to emotional information and social signals given by others, which in turn can elicit interpersonal and behavioural disturbances (Beeney et al., 2015). This is consistent with Young's (2000) schema theory which considers individuals with BPD appear to have a wide range of maladaptive negative schemas relating to the self and others (Sieswerda et al., 2007; Nordahl & Nysæter, 2005), and it has been suggested that there may be an abandonment schema unique to BPD (Reeves & Taylor, 2007). These negative schemas bias processing of social information, as schema-specific information is highly prioritised and difficult to inhibit (Beck et al., 2006).

This could explain why individuals with BPD display increased reactivity to interpersonally stressful situations (Lazarus et al., 2014), negative schemas (or internal working models) of self-and others leads to higher levels of sensitivity to aversive stimuli, particularly to subtle cues of abandonment and rejection (Bowles, Armitage, Drabble & Meyer, 2013; Meyer, Ajchenbrenner & Bowles, 2005; Roepke, Vater, Preißler, Heekeren, & Dziobek, 2012). Social cognitive impairments may be further amplified by interpersonal distress (Williams et al., 2015), individuals with BPD have low distress tolerance (Linehan, 1993) and an inability to disengage attention from negative emotional stimuli (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009). Therefore, they may use self-harm as a way of escaping the highly aversive negative affect (Korner, Gerull, Stevenson, & Meares 2007; Linehan, 1993).

Not surprisingly then, deficits in social cognition have been identified as important contributing factors to self-injury (Williams et al., 2015). A recent study by Williams and colleagues found that individuals with BPD who displayed high lethality self-harm (compared to BPD individuals with low lethality self-harm) had social cognitive deficits, specifically misidentifying happy facial expressions and difficulty perceiving subtle differences in sad facial expressions. In addition, they also displayed deficits in executive functions, specifically response inhibition and inefficient problem solving. The authors suggest that this combination of deficits in executive function (response inhibition and problem-solving) and social cognition may contribute to self-harm. In contexts of high emotional distress (typically triggered by an interpersonal crisis), poor problem solving may narrow the range of perceived alternative behaviours available to regulate negative affect, whilst poor inhibition may make them more likely to self-harm by acting on the spur of the moment without considering the consequences of their actions.

Whipple and Fowler (2011) found that patients with BPD who self-harmed (compared to BPD controls) were significantly more impaired on every domain of social cognition and object relations on a Thematic Apperception Test (TAT; Murray 1943; in which participants create narratives from pictures). They had greater expectations of malevolence from others, expressed less investment in interpersonal relationships, and displayed more hostility and aggression in relationship narratives. Taken together, the evidence in this section supports the notion that social cognition may be the mechanism by which attachment orientation influences BPD features and may contribute to self-harm (Williams et al., 2015). These social cognitive deficits, in conjunction with executive function deficits, may represent a trait-like vulnerability for individuals who are at increased risk of self-harm. This is further

evidence that the interaction between biological vulnerability and a suboptimal childhood environment is a core aetiological factor for BPD (Linehan, 1993; Fonagy & Bateman, 2008; Meyer & Pilkonis, 2005) and possibly self-harm. However, these findings are preliminary and more research of social cognition in self-harm in warranted.

Chapter 6 Methodological Considerations

6.1 Overview of the Chapter

This chapter introduces the methodology used for this series of studies, and discusses how it guided data collection and analysis. General methodological considerations are discussed in this chapter, specifically issues with operationalising and measuring the variables of self-harm, BPD features, executive functions, and attachment. This section also includes a discussion of the ethical considerations involved in this research project.

6.2 Variables and Measurement

6.2.1 Measurement of self-harm.

The majority of studies focusing on self-harm typically use self-report measures (Nock and Prinstein, 2005), but there is little consistency in the published scales which can hinder comparison across different studies (Gratz, 2001). For example, some behaviours are less likely to be endorsed than others are (e.g., chemical burns are relatively rare, but cutting is extremely common), so uncommon types of self-harm are typically not included in some measures which can influence estimates of prevalence and methods of self-harm (Klonsky, 2007). Because of this reliance on self-report measures, the actual questions used can be particularly important, and as Lundh, Karim and Quilisch (2007) point out, can lead to quite divergent results concerning rates of self-harm. For example, Lundh et al. discuss several studies that use just a single question to assess self-harm, however the wording is crucial as it can affect the sensitivity, and therefore the validity of the single item, depending on how the participant interprets the phrase 'self-harm'. Lundh et al. suggest that this issue could be overcome by the use of a measure with

a list of predetermined self-harming methods and by asking participants to choose from the list the behaviours in which they have engaged. In support of this, Gratz (2006) suggests that behaviourally oriented questions could improve the various issues, as well as avoiding misunderstanding of the term 'self-harm', since participants can simply choose which of the behaviours they have engaged in, rather than attempting to work out whether their experiences fit in with a supplied definition. However, specific behaviours listed in a scale can then lead to inflated rate of reporting thereby influencing prevalence rates (Latimer et al., 2012).

Lundh et al. (2007) suggest that collecting self-harm data by behavioural description regardless of suicidal intent is the most sensible way to go since reasons behind acts of self-harm can be so complex and the suicide intent may be ambivalent. However, there are distinct differences between patterns of behaviour and their correlates for those people who are trying to kill themselves compared with those that are not. For this reason, the current series of studies will use a definition of self-harm that occurs in the absence of suicide intent. A further theoretical bias exists, as pointed out by Romans and colleagues (1995), in that there is no way to collect data from those people who have a history of self-harm but have gone on to die by suicide which given the links between self-harm and suicide, may be a substantive number of people. There is, of course, no way to fully overcome this, so such a bias does not affect comparisons among studies, it only suggests the possibility of differences in variables between these people and those who do not die by suicide, that are unable to be investigated.

6.2.2 Measurement of BPD features.

Structured (or semi-structured) clinical interviews are typically the norm in clinical assessment and diagnosis of psychiatric disorders. Interviews for BPD

generally show an adequate inter-rater reliability (> .8) (Miller, Muehlenkamp, & Jacobson, 2008). However, interviews are time consuming for clinicians and patients alike, and so are not particularly suitable for routine clinical practice and research purposes (Jacobo, Blais, Baitey, & Harley, 2007). Therefore, valid self-report measures that can be administered quickly and to large numbers of participants have utility in both clinical practice and research. In addition, these instruments can also be useful as screening tools (Chanen et al., 2008). This series of studies will use a range of self-report personality measures in order to provide more reliable and detailed measures of BPD features (e.g., Cheavens et al., 2005; Sprague & Verona, 2010).

6.2.3 Measurement of executive functions.

There are various issues to consider when choosing appropriate EF tasks. For example, the fact that a task can only be 'novel' (and therefore require more attention) the first time it is administered to a participant, any subsequent testing may show improvements due to practice effects and familiarity with the task. In addition, individuals can improve performance if they discover an optimal strategy, or performance may decrease if they use a poor strategy, thus contributing to the poor test - retest reliability. Strauss and colleagues (2006) recommend using multiple tasks to overcome this problem. Miyake et al. (2000) also supports the use of multiple tests, as well as making the argument for measuring any additional variables that have been implicated in EF, in order to statistically control for their effects. For example, EFs and Intelligence Quotient (IQ) generally tend to overlap. Thus, poor functioning on an EF task could simply reflect a lower than expected IQ, rather than EF deficits (Strauss et al., 2006). Other variables that may influence EF task performance include past/current alcohol or substance abuse, ADHD, learning

disability, medication, depression, and anxiety, all of which can influence EF performance (LeGris and van Reekum, 2006).

Another important issue to consider when choosing an EF assessment tool is so called 'Task Impurity', this is the assumption that any measure of EF will be strongly implicated in other cognitive processes of which the researcher will be unaware of (LeGris & Van Reekum, 2006). This is because any EF test must involve other (nonexecutive) cognitive processes, as by definition executive functions are there to operate on non-EF functions (Strauss, Sherman & Spreen, 2006). Similar to the problem with IQ, it may be that a low score on an EF task does not actually represent a deficit in an EF process. To address this issue, it is important to follow the recommendations made by Miyake et al. (2000) that the researcher precisely understands the nature of the construct they are measuring and choose appropriate measures.

This series of studies will use a range of executive function measures, incorporating both self-report measures and researcher-administered standardised behavioural tasks to maximise detection of EF deficits or impairment. For the self-report measure, the Attentional Control Scale (ACS - Derryberry & Reed, 2002) was used, and for the researcher-administered tasks it was decided to use a selection of tasks from the Delis Kaplan Executive Function System (D-KEFS; Delis et al., 2001), alongside The Hayling Sentence Completion task (Burgess & Shallice, 1997) and a bespoke attachment-based Stroop task. Both the Hayling and the Stroop task provide a measure of inhibition, a feature that has been shown to be problematic for individuals with BPD (APA, 2013; Ayduk et al., 2008). In addition, response inhibition, as measured by Stroop interference, is closely linked to suicidal ideation and suicide risk in BPD (Coolidge, Thede & Jang, 2004).

6.2.3.1 The Delis Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001).

The Delis Kaplan Executive Function System (D-KEFS; Delis et al., 2001) is a battery of standardised and stand-alone tests that can comprehensively assess verbal and non-verbal executive functions in both adults and children. The D-KEFS was developed to tap fundamental cognitive skills such as attention, language, perception, and higher level skills such as initiation of problem solving behaviour, abstraction, and cognitive flexibility. The D-KEFS was developed to address a number of criticisms often levelled at executive function tasks. A common criticism of neuropsychological tasks is that they are insensitive to relatively mild or subtle EF deficits. However, tasks that are sensitive enough to detect subtle deficits may be too difficult for individuals with severe functional impairment or brain damage. The D-KEFS is designed to yield useful data across the spectrum, such as by raising the threshold of processing demands in order to maximise the detection of subtle EF deficits, one of the ways the D-KEFS does this was by introducing 'switching' components to tasks. Cognitive flexibility (or set switching) is considered to be one of the 'hallmark' executive functions primarily attributed to the frontal lobe (Delis et al., 2001), and refers to the ability to abandon a response in order to generate a new response. For example, The D-KEFS Sorting Task places extensive demands on cognitive flexibility, because participants are required to identify a maximum of 16 different conceptual rules, which is higher than most traditional concept formation tasks.

The D-KEFS tasks are administered and scored according to the standardised instructions presented in The D-KEFS Examiner's Manual. Most tasks yield multiple measures of executive functioning, such as primary and secondary

measures, combined measures, and error analysis, which can provide performance on key components of the task, and global achievement scores reflecting overall performance. Optional measures can also be calculated, which can provide a profile of spared and impaired EFs for each participant. Contrast scores allow comparison of performance on one condition of a task relative to performance in a different condition (e.g., for the verbal fluency task: letter fluency vs. category fluency), which can show the degree of difference in performance. For most of the measures provided by the D-KEFS, raw scores are converted to scaled scores which have a mean of 10, and a standard deviation of 3, corrected for age groups as well as the cumulative percentile ranks for some measures. Higher scaled scores on a task typically represent better performance and fewer errors, the exception being contrast scores. Both low and high contrast scores may reflect specific different types of cognitive deficits, depending on the task.

Using the D-KEFS has a number of advantages, for example it is the first battery of EF tests that has been normed to a relatively large dataset and it is also one of the first EF tests that can measure and distinguish between higher level functions and lower level, more basic functions (Homack, Lee and Riccio, 2005). However, Homack et al. acknowledges that there are also problems to address with using the D-KEFS as a measurement tool, the task instructions are somewhat complex and repetitious, and consequently Homack et al. argue that some of the measures included in the D-KEFS battery may not yet be ready or suitable for clinical use.

In total, the D-KEFS battery contains nine tasks, and administration of the whole battery would take approximately 90 minutes (Strauss et al., 2004). However, the D-KEFS test selection is designed to be flexible, to allow researchers and

clinicians to tailor their battery to individual participants or specific research questions. Therefore, each of the D-KEFS tests can be used as stand-alone measures, and in combination with other D-KEFS tasks. Three tasks were chosen from the D-KEFS battery for use in this series of studies. The Verbal Fluency Task was selected because verbal-fluency performance is the component most strongly related to emotional regulatory ability, and results have shown that higher verbal fluency performance is related to successful regulation of emotional responses (Gyurak et al., 2012a). The Design Fluency Task was selected because it is a non-verbal analogue of the Verbal Fluency Task and therefore provides a non-verbal measure of cognitive fluency. The Design Fluency task also measures response inhibition, which has been shown to be a particularly problematic for individuals with BPD who struggle to inhibit their urge to self-harm (Ayduk et al., 2008). Indeed, disinhibition is a criterion for BPD in the alternative hybrid model (APA, 2013). The Card Sorting Task was selected because it provides multiple measures of executive functioning in multiple domains; it measures response inhibition, but also problem solving skills. This is important because poor decision making may also contribute to the recurrent self-harm and suicidal behaviour, because it leaves individuals vulnerable to act on dominant tendencies, even if maladaptive (Spada, Georgiou, & Wells, 2009). The procedure, scoring and normative data for the three D-KEFS tasks are described in detail in the D-KEFS administration manual.

6.2.3.3 The Hayling Sentence Completion Task (Burgess & Shallice, 1997).

The Hayling Sentence Completion task, developed by Burgess and Shallice (1997), requires individuals to complete sentences with a context appropriate word (part 1) (initiation condition) followed by a context inappropriate word (part 2)

(inhibition condition). For example, in part 1 the participant is asked to complete the sentence: '*The house will be torn… (down)*'; whereas in part 2 participants need to complete the sentence with an inappropriate word, such as '*The captain wanted to stay with the sinking… (banana)*'. In part 2, participants have to inhibit what would be their automatic response, and generate an inappropriate word. Consequently, the Hayling task measures both initiation speed and response suppression, thereby tapping into the ability to shift attentional sets. Response latencies from part 1 and 2 are calculated, and combined with the error score from part 2 to give an overall score.

The Hayling task is suitable for use in adult populations (age 18 - 80) but has been used with children and adolescents (see Strauss et al., 2006). It appears to have variable split-half reliability (.35 - .83) and adequate test-retest reliability for overall scores, but there appears to be no research related to inter-rater reliability for the Hayling (Strauss et al., 2006). A major advantage of the Hayling task is that it takes approximately 5 minutes each to administer, and can be used with adults aged 18 – 80. A high IQ has been associated with fewer faults on the Hayling task (Lezak, Howieson and Loring, 2004), so caution is advised when using them with individuals with a low IQ. A disadvantage of the Hayling task is that the task is considered relatively simple, so patients with minimal executive dysfunction may not exhibit any significant impairment on these tasks.

6.2.3.4 The Stroop Task paradigm.

The Stroop task paradigm (Stroop, 1935) is perhaps one of the oldest techniques for measuring inhibition processes (MacLeod, 1991). The original Stroop design combines words and colours, to create a cognitive conflict. For example, the word 'green' would appear in congruent colour (e.g., in green ink) and then in an

incongruent colour (e.g., in red ink). Participants are asked to name first the word, and then the colour of the ink the word is printed in, whilst ignoring the word itself. Stroop found that colour naming was significantly slower for incongruent colour words, and this delay is the traditional 'Stroop effect', or response interference (MacLeod, 2005). The Stroop paradigm has been referred to as the 'gold standard' of attentional measures (MacLeod, 1992).

The emotional Stroop task was designed to investigate the association between attentional bias and emotion, which can measure attentional biases for emotional stimuli (e.g., Williams, MacLeod and Mathews, 1996). The emotional Stroop task typically demonstrates that performance (naming colours) suffers as a result of selective attention towards emotional content (Williams et al., 1996). The emotional Stroop task is useful in establishing the extent to which attentional biases can maintain emotional psychopathology and has been used in a wide variety of psychopathological groups such as those with anxiety and phobias (Williams et al., 1996). However, correlations between different versions of the task tend to be moderate in nature at best (Strauss et al., 2006). In addition, it is possible that the Stroop test is not strictly measuring executive functions per se. Research shows that the Stroop task may load on factors that reflect cognitive processing speed rather than EF (Burgess et al., 2006). Therefore, caution is required when interpreting the results from Stroop tasks when using them purely as a measure of EF.

There is now a plethora of different variations of the Stroop task. Previous studies (e.g., Atkinson et al., 2009; Edelstein & Gillath, 2008; Haydon, Roisman, Marks, & Fraley, 2011; Mikulincer, Dolev, & Shaver, 2004) have used a version of the Stroop task using attachment-based stimuli, however these tasks either contained too few attachment related words (e.g., Edelstein & Gillath, 2008), were

not clearly matched for length and frequency (Haydon et al.), were not independently rated for emotional valence (Atkinson et al.) or were in a language other than English (e.g., Hebrew in the Mikulincer et al. task). Consequently, a bespoke Stroop Task based on attachment related words were developed for use in this study. The rationale for an attachment-based Stroop comes from the importance of attachment orientation to both personality disorder features and neuropsychological development, and the fact that previous studies have used attachment-related stimuli to measure cognitive effort (Beckes, Simpson, & Erickson, 2010; Edelstein & Gillath, 2008; Mohr, Rowe, & Crawford, 2007; Rowe & Carnelley, 2003). Additionally, individuals with BPD tend to show increased interference compared to Healthy Controls (HCs) (LeGris et al., 2012; Sieswerda et al., 2006), especially for emotion related words (Black et al., 2009), and Stroop interference is negatively correlated with suicide risk and number of lifetime suicide attempts (LeGris et al, 2012). As discussed in section 4.2, 'cold' cognitive processing and 'hot' emotional processing are intimately linked via a network of brain regions that monitor for salient information, maintain and focus attention, suppress irrelevant responses (inhibition) and select appropriate responses (Bush, Luu, & Posner, 2000; Compton et al., 2003; Miyake et al., 2000; Ochsner et al., 2002).

6.2.4 Measurement of attachment.

Measurement of attachment behaviours typically take the form of an interview, such as the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1996; Hesse, 2008) or self-report methods, such as the Experiences in Close Relationships Questionnaire (ECR; Brennan, Clark, & Shaver, 1998). The AAI aims to measure *unconscious* aspects of attachment-related defences and behaviours, and is considered the most established instrument for measuring attachment and has

excellent psychometric properties (Ravitz, Maunder, Hunter, Sthankiya, & Lancee, 2010). However, it requires significant resources, time and training to administer, and transcription and coding can be an arduous and time consuming process (Ravitz et al., 2010). Consequently, self-report methods are commonly used by clinicians and researchers, and are considered good for measuring conscious attitudes and behaviours in current relationships (Ravitz et al.).

Unlike the AAI, self-report measures directly assess *conscious* attitudes towards experiences of separation, loss, intimacy, dependence, and trust (Mikulincer & Shaver, 2007; Ravitz et al., 2010). Although self-report methods of attachment could be criticised because they may not detect phenomena that need to be activated to be manifested (Ravitz et al., 2010), it is generally accepted that self-report methods are predictive of attachment-related dynamic processes, and prominent researchers have concluded that there is little argument for the greater validity of interviews over self-report measures (Bartholomew & Moretti, 2002).

Contemporary conceptualisations of adult attachment generally consider it to be made up of two fundamental dimensions of attachment-related anxiety and attachment-related avoidance (Brennan, Clark & Shaver, 1998; Fraley & Waller, 1998; Griffin & Bartholomew, 1994; also see section 5.2). The two attachment dimensions of anxiety and avoidance will be measured using the 36-item ECR (Brennan, Clark, & Shaver, 1998; see also Appendix B. 3). The ECR was developed from a principal components analysis of 323 items from 60 self-report measures of attachment to provide a 'definitive measure' of attachment (Levy, Ellison, Scott, & Bernecker, 2011). The ECR taps attachment avoidance (e.g., 'I prefer not to show a partner how I feel deep down') and attachment anxiety (e.g., 'I worry about being abandoned') and participants respond using a 7-point response scales ranging from

'Disagree strongly' to 'Agree strongly'. The ECR is considered to have good validity and excellent reliability (Ravitz et al., 2010; see Mikulincer & Shaver, 2007, for a review) and consequently has been used in hundreds of studies (Ravitz et al.).

6.3 Ethical Considerations

All research projects will be carried out in accordance with the British Psychological Society's (BPS) code of human research ethics (2010) and will be reviewed and approved by Sheffield Hallam University's Research Ethics Committee (REC).

6.3.1 Informed consent, withdrawal of data, and debriefing procedures.

Participants will be made aware of their rights as a participant, which includes their right to withhold and withdraw data without penalty, issues of confidentiality, and risks and benefits of participation. In addition, they will be provided with contact details for the lead researcher and supervising academic, should they wish to discuss their participation in more detail. This information is presented in a Participant Information Sheet (an electronic version will be used for the online studies) which participants are required to read prior to participation. Because of the nature of the topic that is being researched, the information sheet will also contain contact details for relevant organisations should participants wish to discuss any issues with appropriate sources (e.g., The Samaritans and the University counselling service). Participants are then asked to sign an informed consent form (or tick a box for the online studies) indicating that they fully understand the information they have been given, their rights as a participant, and have also had the opportunity to discuss their participation with the researcher.

6.3.2 Confidentiality and data protection.

Under the Data Protection Act (1998) information obtained from and about a participant during research is confidential unless otherwise agreed in advance. Consequently, the data collected in this thesis will be instantly anonymised so that in the final publication no participants will be identifiable. In addition, all raw data will only be available to the principal research team. Hard copies of data will be kept securely on the university campus in a locked cabinet to which only the lead researcher has access. All electronic data will be kept securely on the university server. In the event it needs to be transferred, the electronic data will be stored on a military level security flash drive (Advanced Encryption Standard 256 bit). All data will be kept until the researchers degree has been ratified, unless the data (excluding any personal data such as email addresses) is requested by a data repository for data sharing purposes. Signed consent forms will be stored separately from the collected data to further protect any individuals being identified.

6.3.3 Feedback and advice.

Participants will not generally be given feedback on their scores on personality measures or their performance on tasks; however it is anticipated that some participants may request feedback, particularly their IQ score. In this case, participants will be provided with their personal scores, along with mean scores, and guidance to aid understanding and interpretation. Feedback will only be given to those participants who specifically request it either before or during the data collection phase, because feedback cannot be given retrospectively dues to the data being anonymised immediately after collection.

In addition, participants may ask for advice on personality or health issues. The BPS guidelines state that it is the responsibility of the researcher to provide

appropriate advice if asked, however if the researcher is not competent in this area then they should instead refer the participant to appropriate sources of guidance. If the situation arises where a participant requests advice on any of the issues raised by participating, there are a number of options available. In the case that the participant is a university student, they can be referred to the university counselling service. If participants are not connected to the university, then they can be advised to contact their GP to discuss their mental health needs. In the case of immediate distress, participants can be advised to contact a mental health charity (e.g., The Samaritans) or the nearest accident and emergency department.

6.3.4 Internet mediated research (IMR).

Self-report data will be collected online using the SurveyMonkey and Qualtrics websites. The online data collection will abide by the principles and suggestions set out in the BPS guidelines for research online (2007). These are not separate guidelines, but rather a supplement to the general research principles discussed previously. Although internet mediated research can be a useful tool for accessing communities and discussion built around certain topics, it has its own unique problems. There can be a blurring between public and private space, for example contact by email (which is generally considered private by most internet users) can compromise confidentiality and anonymity, unless it is conducted via appropriately secure servers, such as those of a university.

Naturally, when collecting data online it can be somewhat problematic to gain informed consent. To ensure that participants are given all the information they need in advance of participation, the first page participants see when entering the survey is the 'briefing' page (see Appendix D.3). This page makes an explicit warning that self-harm will be under discussion and advises them not to participate if they think

they may be affected or upset by the content. In addition, it contains information about informed consent. Participants are also made aware of their rights as a participant. By checking the 'I understand' option and then clicking on the 'next' button to start the questionnaire will be taken as consent to participation.

A further safeguard is in place when participants reach the part of the study referring to self-harm, they are again warned explicitly by a message on the screen alerting them to the discussion of sensitive topics. Again, they are advised not to continue if they feel they may be vulnerable to any negative effects. At both of these stages, and also on the debriefing screen at the end of the study, the telephone number and email address of The Samaritans is given, should participants have been negatively affected after the warnings. Participants are also reminded that they can exit the study at any time by clicking on the 'x' in the top left hand corner of the webpage.

Data collection on the internet will be by means of an online survey site (Surveymonkey.com or Qualtrics.com). The privacy policy (2014) for Qualtrics states the use of 'cookies' to collect data from all participants who enter the site. However, this is restricted to IP address, internet service provider, browser type and other technical data. The technical information collected by SurveyMonkey and Qualtrics does not allow identification of any individual participants, and the anonymous data is aggregated and used to analyse trends and usage of the site. The data will then be stored securely in electronic form on the university server until the degree has been ratified.

One advantage of collecting data online is that it allows anonymity, which can partly address the problem of reluctance to disclose self-harm behaviour due to the shame that is often associated with it. Feeling ashamed of self-harm behaviour may

reduce the extent to which people who self-harm are willing to admit it to another person in an interview situation, compared with writing it anonymously on a questionnaire. Whitlock and colleagues (2006) used online data collection measures relating to self-harm, suggested that it allows for not only anonymity, but also leads to an increased likelihood of truthfulness in responses. Given that individuals who self-harm are typically considered a difficult group to engage in research (Hawton & Sinclair, 2003; Clarke et al., 2004); the online methodology seems to be an appropriate way of targeting this population.

6.3.5 Risks and benefits of participation.

This study cannot guarantee any direct benefits to the participant, however it is hoped they may gain some level of insight into their own behaviour. Self-harm is intrinsically a private and secretive type of behaviour, and so shame and isolation are usually barriers to individuals discussing their self-harm behaviour (Whitlock, Powers & Eckenrode, 2006). Research shows that allowing individuals to discuss self-harm anonymously can be beneficial to their social and emotional development (Whitlock et al., 2006). In addition, and perhaps somewhat counter-intuitively, participants taking part in trauma focused research (childhood sexual abuse, rape), report very few adverse reactions, and in a large number of cases they actually derive some form of positive benefit (Newman, Walker, Gefland, 1999). Moreover, participating in this research project will inform future research and treatment interventions for BPD and self-harm. Therefore, it may provide some indirect benefit in the future.

Participants will be asked to answer questions on their own self-harming behaviour, which could be considered a sensitive topic. The BPs guidelines consider 'sensitive topics' to be those that involve more than minimal risk. Although

it could be argued that the benefit of understanding self-harm provides long-term gains and benefits that may offset the immediate risk to participants, any possible risks still need to be minimised. There is virtually no research on the possible implications of enquiring about self-harm related behaviour; it is possible that discussion about the behaviour could 'trigger' the individual (Whitlock, Lader & Conterio, 2007). Research by Stanford and Jones (2010) suggest that using a brief and impersonal measure like self-report questionnaires when asking about potentially sensitive topics is likely to minimise distress, and in addition can increase accuracy and honesty in participants' responses. It is also suggested that including a 'prefer not to answer' option in the measure allows a participant to decline to answer a question. Consequently, all participants will be briefed in advance that participation involves discussion of self-harm type behaviours, and will be encouraged not to participate if they think this may pose a risk to their mental or physical health. In addition, discussion of self-harm will be kept to a minimum by the use of a brief self-report measure (the DSHI) in order to minimise participants' exposure to potentially distressing stimuli.

Chapter 7 Overview of Studies

7.1 The Case for Selection of BPD Features and Self-harm

The choice of BPD and self-harm as the focus of this thesis was guided by possible shared deficits in neurobiological mechanisms (e.g., executive functions) (LeGris & Van Reekum, 2006), similarities in attachment insecurity (Agrawal et al., 2004; Suyemoto, 1998), and difficulties with affect regulation (Klonsky, 2007; Linehan, 1993). Both BPD and self-harm have high prevalence rates (Briere & Gil, 1998; Zanarini et al., 2008) and are of high clinical importance (Lieb et al., 2004; Weston, 2003). In addition, the aetiology and maintenance of self-harm behaviours are still poorly understood (Hawton & Harriss, 2007; Glassman et al., 2007) and little is known about the underlying neuropsychological mechanisms that drive self-harm behaviour.

Historically, self-harm has been considered in conjunction with BPD, but is also a significant problem in the general population (Briere & Gil, 1998). Despite such high comorbidity between BPD and self-harm, the nature of the relationship is unclear (Brickman, Ammerman, Look, Berman, & McCloskey, 2014). With the publication of the most recent edition of the DSM, which includes Non-suicidal Self-injury Disorder as a new diagnostic category, research increasingly needs to focus on self-harm across all populations (Hawton & Harriss, 2007). There is strong empirical evidence to suggest that self-harm may function as an emotional regulating mechanism (Brown et al., 2002; Briere & Gil, 1998; Gratz et al., 2009) and this hypothesis is relatively well accepted; however there is still the possibility that self-harm may serve other functions, perhaps some of which researchers are not yet aware (Klonsky, 2007).

7.2 Executive Functions and Attachment Organisation: A new Conceptual Framework for Understanding BPD and Self-harm?

In an attempt to further understand the processes that give rise to BPD symptomology, including self-harm, researchers have begun to draw on neuropsychology research (see section 4.2). One area of interest is the executive function domain. The notion that impaired executive functions might mediate self-harm in BPD individuals deserves further investigation because key symptom clusters characterising the disorder indicate poor behavioural regulation (Coolidge et al., 2004), which are an important marker of executive dysfunction in other patient groups (Morton & Barker, 2010). Affective instability indicated by inappropriate anger, impulsivity and risk-taking behaviour are core features of BPD, and are also seen, to a lesser or greater degree, in neuropathological groups with executive dysfunction (Barker et al., 2010; Barker, Morton, Morrison & McGuire, 2011).

There does appear to be to be a relationship between executive functions and clinically important features of BPD (Ayduk et al., 2008; Hoermann, Clarkin, Hull, & Levy, 2005). Individuals with BPD exhibit deficits in some cognitive domains, particularly attention and the executive functions (LeGris & van Reekum, 2006). In a meta-analysis, 86% of studies showed some degree of impairment in EFs in BPD (LeGris & van Reekum, 2006). Furthermore, Ayduk et al. (2008) concluded that the only neuropsychological domain that was consistently impaired in BPD individuals were the executive functions, in particular inhibition of impulsive acts.

Although executive function deficits have been linked to BPD features, there is little to no research that focuses specifically on the neuropsychological basis of self-harm, either within or independent of a BPD diagnosis. It is probable that diminished executive functions might contribute to incidence of self-harm, because

there is significant overlap between the reasons reported for self-harm in both BPD and non-BPD groups, with both reporting affect regulation as the main function (Gratz & Roemer, 2008; Klonsky, 2009). Therefore, it is a reasonable assumption that individuals who self-harm (regardless of a BPD diagnosis) may do so in order to compensate for diminished affective/executive control, thus providing an outlet for emotional distress that cannot be regulated by normal cognitive and affective regulatory processes.

Similarly, little is known about the specific role of attachment in self-harm behaviour beyond the notion that individuals with insecure attachment organisation are more likely to use maladaptive affect regulation strategies compared to those with secure organisation (Schaffer, 1993; Suyemoto 1998). Attachment theory has been posited as a potential conceptual framework for understanding the development of BPD features, because the core symptoms (including self-harm) and could be considered expressions of underlying attachment insecurity (Fonagy et al., 2011; Meyer & Pilkonis, 2005).

It has been argued that attachment pathologies actually represent inefficient patterns of organisation in the right hemisphere of the brain and manifest in a limited capacity to modulate the intensity and duration of affect (Schore, 2001). There is a compelling link between the quality of the parent-child (and adolescent-child) relationships and cognitive development into adulthood, particularly the development of orbito-frontal cortical and limbic areas of the brain, which are critical to self and emotion-regulation (Schore, 1994; 2000; 2001; 2005). These are the same brain regions that are also heavily implicated in executive functioning (Minzenberg et al., 2008; Schmahl & Bremner, 2006) and are thought to be part of a circuit that serves to regulate both cognitive *and* emotional processes (Bush et al., 2000).

Adverse attachment related experiences can have dramatic consequences on neuropsychological functioning, for example children exposed to family violence exhibit poorer EF performance compared to their peers (DePrince, Weinzierl, & Combs, 2009), and significant changes in brain structure and function have been observed in the orbitofrontal-limbic regions of individuals with a history of childhood maltreatment (Hart and Rubia, 2012). Such early childhood trauma and maltreatment may manifest as neuropsychological impairments in many cognitive domains, including the executive functions (Hart and Rubia, 2012). This is particularly relevant, given that early childhood trauma (Ball & Links, 2009), caregiver neglect (Sabo, 1997), and physical and sexual abuse (Zanarini & Frankenburg, 1997) are commonly reported in histories of individuals diagnosed with BPD.

Attachment organisation appears to be highly bound up with executive functions, and impairment in one (or both) may contribute to the development of BPD features and self-harm. It is not clear if attachment insecurity is a direct manifestation of executive dysfunction, in the sense that cognitive control is necessary to maintain engagement with romantic partners or other significant attachment figures, or if BPD patients (and those who self-harm) employ the emotional and behavioural strategies of attachment insecurity as part of a compensatory strategy for deficient executive regulation (Minzenberg et al., 2008). For example, individuals with BPD will often oscillate between attachment approach strategies (e.g., desire for greater intimacy) and avoidance strategies (Meyer & Pilkonis, 2005), particularly when negative affect is triggered in the context of an interpersonal context. Consequently, it has been argued that BPD patients use emotional and behavioural strategies of attachment avoidance partly as a

compensation strategy for impaired executive regulation of negative affect that arises in attachment/interpersonal contexts (Minzenberg et al., 2008).

Taken together, the evidence suggests that self-harm and BPD features may be a product of a biological (e.g., EFs) and environmental (e.g., adverse childhood experiences) (Minzenberg et al., 2008) interaction, and further research examining the interrelations between executive and emotion systems in BPD and self-harm is warranted (Fertuck, Lenzenweger & Clarkin, 2005). The interface between neurocognition and social cognition is particularly relevant given that BPD individuals have a wide range of social cognitive difficulties (such as inaccurate inferences of social/interpersonal cues, unstable interpersonal relationships, lack of sense of self, idealisation/devaluation; Fertuck et al., 2005). A clearer understanding of how attachment and EFs interact would have profound consequences for further research and practice, because early interventions aimed at mitigating the effects of early childhood trauma on both neurocognitive function and development of attachment orientation, and could possibly reduce the risk for developing BPD or self-harm in later life (Minzenberg et al., 2008).

7.3 Implications of Research

There is an urgent need to understand the aetiology and development of self-harm behaviour in order to reduce the risk is poses, therefore the proposed mediators and moderators investigated in this thesis may have wide reaching implications. For example, if specific deficits in executive control are found to contribute to self-harm behaviours, appropriate interventions and therapies can be implemented. Attentional control training, in which patients are taught strategies and skills to control their attention and divert it away from internal emotional states, has already been shown to increase emotional regulation in individuals with BPD (Lynch,

Chapman, Rosenthal, Kuo, & Linehan, 2006). Attentional control training therefore has the potential to become an important component in psychotherapy for BPD and self-harm (Selby et al., 2009).

This is perhaps not surprising given that it shares common ground with the concept of 'mindfulness' which is used as a technique in DBT (Linehan, 1993). 'Mindfulness' teaches control over attentional processes in order to reduce negative affect, whilst simultaneously blocking the use of unhelpful, avoidance mechanisms that the individual may normally use to escape from emotional distress, such as self-harm (Lynch et al., 2006). Attentional control is also conceptually similar to 'mentalization', which is a core part of Mentalization Based Treatment (MBT), in which individuals are taught awareness and control of internal mental states (Eizirik & Fonagy, 2009). In addition, the main thrust of Transference-Focused Psychotherapy (TFP) is to facilitate control of affect and behaviour through flexibility of thought (Clarkin et al., 2006). There are, of course, differences in the theoretical paradigms that underpin these different methods of therapy, but they do share important overlaps since the general aim is to teach skills which help individuals with BPD distract themselves from their negative emotional internal states (Levy, Clarkin, Yeomans, Scott, Wasserman & Kernberg, 2008). If this series of studies can identify which particular EFs are implicated in playing a role in self-harm behaviour, this knowledge can help to inform treatment options for specifically targeted interventions or skills training.

7.4 Summary of Proposed Studies

The aim of this series of studies is to investigate the role of executive functions and attachment orientation in self-harm and BPD features. The studies presented in this thesis extend the recent research that has begun to examine how

both self-harm and BPD features may be a product of biological (e.g., EF) and environmental (e.g., attachment experience) interactions (Minzenberg et al., 2008). The flow of these studies is designed to develop the idea that the interaction between neurocognition and social cognition is particularly relevant to both self-harm and BPD. It is hoped that this thesis will make an important contribution to the understanding of self-harm behaviour both in BPD and general populations, and will have important conceptual and clinical implications by contributing to the current body of knowledge which attempts to understand the possible aetiological mechanisms in self-harm and BPD.

7.4.1 A note on the mediator and moderator distinction.

A moderator is a third variable (or process) that affects the direction and/or strength of the relationship between a predictor variable and dependent (or criterion) variable, whereas a mediator is a variable that accounts for some of the relationship between the predictor and the criterion variable. Mediators explain how external physical events take on internal psychological significance (Baron & Kenny, 1986). A variable (or process) can function as either a mediator or moderator, or both roles simultaneously, especially for processes that evolve and operate over a long period of time (Hayes, 2013). For example, attachment organisation has been shown to function as both a mediator and a moderator in emotional regulation (Adam, Gunnar & Tanaka, 2004) and problem drinking (El-Sheikh & Buckhalt, 2003). Theoretically then, both attachment insecurity and executive functions may explain the relationship between BPD features and self-harm (e.g., a mediator), and as a variable that alters the strength of the relationship between BPD features and intent to self-harm (e.g., as a moderator), consequently both types of relationships will be explored in this series of studies.

7.5 Summary of Aims and Hypotheses

The first study aims to investigate the putative relationship among levels of BPD features, three aspects of attentional/executive control, affect, and self-harm history. Specifically, this study aims to investigate the moderating effect of attentional control on the relationship between self-harm and BPD features. Therefore, Study 1 will contribute to the literature on the role of attentional control in BPD (e.g., Ayduk et al., 2008; Hoermann et al., 2005) and self-harm. This is relatively novel as only one study so far has investigated the role of executive attention specifically in relation to self-harm (Dixon-Gordon et al., 2014). The study by Dixon-Gordon and colleagues used the Attention Network Task (Fan et al., 2002) and found that there were significant deficits in executive attentional functioning between those participants who currently self-harm compared to those who do not. The hypotheses are that deficits in specific components of attentional control (focusing, shifting, and flexibility) would be related to BPD features and self-harm, and that attentional control would mediate and/or moderate the association between BPD features and self-harm.

Study 2 measured executive functions by a range of standardised EF measures alongside the ACS. The rationale for this is to address concerns that subjective reports about attentional control are not similar to objective indices of attentional control (Verwoerd, de Jong, & Wessel, 2008). Therefore study 2 will develop new experimental paradigms using a comprehensive raft of standardised cognitive tests to further tease apart the putative relationship between executive control and self-harm likelihood. Selection of the EF tasks was guided by the literature; and tasks were chosen that measured the EF components of cognitive fluency, inhibition, problem solving, and shifting of attentional sets as all these

particular EF components have been linked to BPD features and self-harm behaviour. The hypotheses were that deficits in specific components of EFs would be related to BPD features and self-harm, and that EF would mediate or moderate the association between BPD features and self-harm.

In study 2, attachment organisation was again proposed as a possible mediator or moderator of the relationships among EF, BPD traits, and self-harm. To investigate the role of attachment to BPD and self-harm, a number of different methodologies will be incorporated. Alongside a self-report measure of adult attachment, an experimental vignette approach will be used (Atzmuller & Steiner, 2010) to study the extent to which intent to self-harm might vary as a function of attachment insecurity and social cognition (self and other-esteem) after exposure to the vignettes.

It was hypothesised that components of executive function along with BPD features would be associated with self-harm likelihood in a non-clinical sample. Specifically, it was hypothesised that that individuals who report previous self-harm will exhibit executive function deficits and higher levels of BPD feature compared to controls. In addition, it was anticipated that EF deficits might mediate and/or moderate the association between BPD features and self-harm. It was further hypothesised that increased levels of attachment insecurity (avoidance and anxiety) would be present in the self-harm group compared to controls. It was also predicted social cognitive processing biases in the form of reduced self and other-esteem would be observed, and an increased likelihood of self-harm harm after exposure to the abandonment and rejection related vignettes would be present in the self-harm group. Finally, it was predicted that attachment organisation would mediate and/or

moderate the relationship between BPD features and intent to self-harm after exposure to the vignettes.

The third study aims to explore the relationships among attachment organisation (measured by avoidance and anxiety), executive functions (attentional control and switching), self-esteem, BPD traits, and self-harm behaviour. The methodology was designed to be relatively simple in order to be suitable for use online, and to reduce participant burden. It was hypothesised that deficits in components of executive function (Attentional Control, and switching), attachment insecurity, and BPD features would be associated with self-harm likelihood in a non-clinical sample. Specifically, it was hypothesised that individuals who report previous self-harm will exhibit higher BPD features and executive function deficits (as measured by lower scores and switching cost on the Plus-Minus task), and increased levels of attachment insecurity and reduced global self-esteem in the self-harm group compared to controls.

Like the previous study, vignettes will be used to study the extent to which intent to self-harm might vary after exposure to varying levels of interpersonal rejection. Unlike the previous study, self-esteem will be manipulated using false feedback. As self-esteem in BPD is highly contingent on interpersonal feedback, it was predicted that supportive (or positive) feedback should lead to increased self-esteem and consequently a reduction in the future intent to self-harm. Conversely, ambiguously critical or negative feedback should lead to a decrease in self-esteem, and consequently an increase in intent to self-harm. It was also predicted that there would be social cognitive processing biases in the form of increased likelihood of self-harm harm after exposure to the abandonment and rejection related vignettes because of reduced self-esteem. Finally, it was hypothesised that EFs (both self-

reported and plus-minus task) and self-esteem will mediate and/or moderate the relationship between BPD features and intent to self-harm after exposure to the vignettes.

Chapter 8 Study 1 - Investigating the Role of Executive Attentional control to Self-harm in a Non-clinical Cohort with Borderline Personality Features

8.1 Overview of the Study

Self-harm is a frequently reported maladaptive behaviour in the general population and a key feature of BPD. Poor affect regulation is strongly linked to a propensity to self-harm, is a core component of BPD, and is linked with reduced attentional control abilities. The idea that attentional control difficulties may provide a link between BPD, negative affect and self-harm has yet to be established. The present study explored the putative relationships among levels of BPD features, three aspects of attentional/executive control, affect, and self-harm history in a sample of 340 non-clinical participants recruited online from self-harm forums and social networking sites. Analyses showed that self-reported levels of BPD features and attentional focusing predicted self-harm incidence, and high attentional focusing increased the likelihood of a prior self-harm history in those with high BPD features. Ability to shift attention was associated with a reduced likelihood of self-harm, suggesting that good attentional switching ability may provide a protective buffer against self-harm behaviour for some individuals. These attentional control differences mediated the association between negative affect and self-harm, but the relationship between BPD and self-harm appears independent. Supplementary material for Study 1 is included in Appendix C.

8.2 Introduction

Self-harm, intentional injuring of one's body tissue, is a core feature of BPD and may be also seen in a diverse range of psychiatric disorders (Briere & Gil, 1998). Self-harm is thought to have a general population prevalence of around 4%,

rising to 21% in clinical populations (Briere & Gil, 1998), and 89% in individuals diagnosed with BPD (Zanarini et al., 2008). Estimates show that there are 140,000 - 170,000 admittances to UK hospitals for self-inflicted injury per year (Hawton et al., 2007), and self-harm constitutes one of the commonest reasons for hospital admission (Weston, 2003). While the exact role of self-harm to the maintenance or attempted management of psychiatric symptoms remains to be established, it may represent a maladaptive form of affect regulation (see Klonsky, 2009, for a review).

Self-harm is one of several key diagnostic criteria for BPD together with frantic efforts to avoid real or imagined abandonment, unstable interpersonal relationships, impulsivity, suicidality, identity disturbance and marked inappropriate anger (APA, 2013; Lieb et al., 2004). BPD affects approximately 1.2% - 6% of the general population (Crowell et al., 2009) and around 10-20 % of psychiatric populations, a relatively large proportion of total number of individuals referred to psychiatric services (Lieb et al., 2004). The elevated risk for individuals with BPD to be admitted to hospitalisation for self-harm is considerable: Sansone and colleagues (2005) found that BPD patients reported more than twice the number of self-harm behaviours than patients diagnosed with another psychiatric disorder. However despite prevalence of mutilative acts and high risk of suicidality in BPD patients, self-harming behaviours need not be present to merit a diagnosis of BPD. It is likely that propensity for self-harm in BPD is a poor prognostic indicator compared to BPD patients who do not self-harm, because BPD patients with self-harm tend to be significantly more symptomatic, prone to suicide ideation, and have more recent suicide attempts than those BPD patients without self-harm (Dulit, Fyer, Leon, Brodsky & Frances, 1994; Soloff et al., 1994).

Prevalence and frequency of self-injurious behaviour in normal and psychopathological groups suggest that some individuals may engage in self-harm to serve some adaptive function, at least in the short-term. This behaviour may be 'adaptive' insofar as it operates as an anti-dissociation mechanism that re-affirms an individual's desire to feel (APA, 2013; Klonsky, 2007). Additionally, self-harm may serve as a means to elicit a response from others and avoid abandonment. However, the most frequently reported reason for engaging in self-harm in chronic BPD patients (Brown et al., 2002) and non-clinical BPD samples (Gratz & Roemer, 2008; Klonsky, 2009) is relief of negative emotion. Hence, for some individuals self-harm appears to be a way of self-soothing and coping with stress and negative affect (Gallop, 2002). Of course, chronic self-harm is a dangerous method of emotion regulation (Mikolajczak et al., 2009), and there is increased likelihood of suicide in self-harmers compared to non-self-harmers in the general population (Hawton et al., 2003; Hawton & Harriss, 2007). Additionally, research shows that self-harmers have significantly worse physical and social functioning and reduced quality of life compared to non-self-harmers in the general population (Sinclair, Hawton, & Gray, 2010).

Despite the prevalence of self-harm in individuals with BPD and in the general population, and the subsequent burden on health care services, it is surprising that potential pathways to self-harm behaviour are not well understood (Glassman et al., 2007). One possibility is that reduced executive function ability may underlie self-harm by diminishing the capacity to self-regulate (LeGris & Van Reekum, 2006). Executive function(s) refers to a range of metacognitive capacities (higher-order attentional and control processes) that co-ordinate/maintain, initiate or inhibit other cognitive and emotional processes (Miyake et al., 2000; Barker et al., 2010; Morton

& Barker, 2010) and govern self-ordered, context-appropriate and goal-directed activity (Baddeley & Wilson, 1988; Burgess & Shallice, 1996a; 1996b; Strauss et al., 2006; Burgess, 2003). Several theories posit a central role of attention to executive function (Anderson, 2003; Daches et al., 2010; Giesbrecht et al., 2004; Jurado & Rosselli, 2007; Muscara et al., 2008; Stuss & Alexander, 2000; Spada et al., 2010). Derryberry and Reed (2002) defined attentional control as comprising three factors; a), ability to focus and sustain attention b), ability to shift attention from one task to another requiring inhibition of response contingencies to the first task in order to engage with the second task and c), flexible thought generation.

The notion that impaired executive/attentional control processes might mediate self-harm in BPD individuals deserves further investigation because key symptom clusters characterizing the disorder indicate poor behavioural regulation (Coolidge et al., 2004), an important marker of executive dysfunction in other patient groups (Morton & Barker, 2010). Affective instability indicated by inappropriate anger, impulsivity and risk-taking behaviour are core features of BPD, and are also seen, to a lesser or greater degree, in neuropathological groups with executive dysfunction (Barker et al., 2010; Barker et al., 2011). Diminished inhibitory capacity increases the likelihood that individuals act on dominant and potentially maladaptive tendencies; in the case of individuals with BPD this may be self-harm. However, that said the precise executive processes diminished in BPD individuals remains to be established, although evidence suggests that they may generally comprise diminished attentional control.

LeGris and Van Reekum (2006) conducted a meta-analysis and found that 86% of studies reviewed confirmed some degree of executive function impairment in BPD individuals; the deficits most often reported fell within the category of attentional

impairment. Ayduk and colleagues (2008) investigated the relationships between attentional control, rejection sensitivity and BPD features in a non-clinical sample using the Attentional Control Scale (Derryberry & Reed, 2002). Results showed that the association between BPD features and level of rejection sensitivity was attenuated in individuals with good attentional control. This finding suggests that good attentional control may provide some emotional buffer to override prepotent maladaptive thought patterns and inhibit dominant and maladaptive behavioural patterns in the face of perceived rejection/abandonment.

In other work Posner and Petersen (1990) defined attentional control as comprising three different but interrelated functions; alerting (achieving and maintaining an alert state), orientating, and executive control (conflict resolution/inhibition). Although the Posner and Peterson (1990) model is somewhat conceptually distinct from Derryberry and Reed's (2002) model of attentional control, both share some definitional overlap and correspond well with Miyake et al.'s (2000) categorisation of executive functions. Importantly, executive control, including orientating to, switching, focussing, and/or inhibiting attention and other cognitive processes, is integral to each theory (Derryberry and Reed, 2002; Miyake et al., 2000; Posner and Peterson, 1990).

To summarise, there is evidence to suggest that individuals with BPD have diminished executive functions; specifically they seem to exhibit deficits in attentional control and inhibiting maladaptive thoughts and behaviours. It has been suggested that they may self-harm in order to compensate for diminished affective/executive control, thus providing an outlet for emotional distress that cannot be regulated by normal cognitive and affective regulatory processes. However, less is known about

what functions might contribute to self-harm in non-clinical groups with and without BPD features.

The present study investigated whether components of attentional control (shifting, focusing and flexibility) as measured by the ACS (Derryberry & Reed, 2002) along with BPD features would be associated with self-harm likelihood in a non-clinical sample. It was predicted that deficits in specific components of attentional control (focusing, shifting, and flexibility) would be related to BPD features and self-harm. Furthermore, it was anticipated that attentional control would moderate the association between BPD features and self-harm.

8.3 Method

8.3.1 Participants.

Given that self-harm is common in both clinical and non-clinical samples (Briere & Gil, 1998), and that normal and abnormal personality structure is essentially the same in both clinical and non-clinical populations (O'Connor, 2002; O'Connor & Dyce, 2001; Costa & Widiger, 1994), a self-referring non-clinical sample (N=340) of participants was recruited via advertisements placed on general social networking sites such as Facebook and Twitter, and in topic-relevant forums such as the 'self-harm awareness group' (http://www.facebook.com/SHAwareness). See Appendix C.2 for the Call for Participants flyer. Participants were aged 16 – 62 (M = 26.94, SD = 10.14), and 279 (82%) were women; 117 (34.41%) participants reported previous self-harm. The two groups did not differ significantly by gender (X^2 (1, N = 340) = .35, $p > .05$), but they did differ significantly in age (U = 9251.00, Z = -4.41, p <. 001), with participants who reported prior self-harm being significantly younger. This corresponds to the pattern of diminished BPD symptoms with advancing age shown in the literature and clinical populations (Zanarini et al., 2007).

8.3.2 Materials and procedure.

All measures were completed online via SurveyMonkey (2012). The current research project was approved by the University's Research Ethics Committee (see Appendix C.1 for ethical approval). Informed consent was obtained via an information screen containing details of the study, issues of confidentiality and the right to withdraw (see Appendix C.3). Potential participants recruited to the study progressed beyond the initial consent screen to provide gender and age details before completing the self-report measures. All participants were debriefed upon completion of the study (see Appendix C.4 for the debriefing information).

8.3.2.1 Attentional control measure.

The Attentional Control Scale (ACS - Derryberry & Reed, 2002) is a 20-item, self-report measure of attentional control which is described in detail in section 6.2.3.1 (also see Appendix B.1). High scores on the ACS represent good capacity to voluntarily control attention, whereas low scores are associated with attentional rigidity. Using the three-factor scale described by Fajkowska and Derryberry (2010); the attention focusing subscale has nine items and refers to the ability to focus and maintain attention (example item: 'It's very hard for me to concentrate on a difficult task when there are noises around'). The attention shifting subscale has six items and refers to the ability to shift attention between focal points (example item: 'I can quickly shift from one task to another'). The flexibility/divided attention subscale has five items (example item: 'I have trouble carrying on two conversations at once'). In the current study, the focusing subscale demonstrated good internal consistency (α = .75), and shifting and flexibility subscale alphas demonstrated acceptable internal consistency for small scales (α = .58 and .56, respectively).

8.3.2.2 Measures of borderline personality features.

The rationale for including three measures of BPD traits is threefold, firstly the Short Coolidge Axis Two Inventory (SCATI - Coolidge, Thede & Jang, 2004) (see Appendix B.5) is a relatively new measure, and so can be validated with the more established measures. Secondly, it will provide a more detailed understanding of the distribution of BPD features in those who report prior self-harm compared to those who do not. Finally, as the three scales are measuring the same underlying construct they can be combined into a composite variable representing BPD features, in order to provide a more reliable measure (e.g., Cheavens et al., 2005; Sprague & Verona, 2010).

The Structured Clinical Interview for DSM-IV Axis II Personality Disorders Screening Questionnaire (SCID-II-SQ, First, Gibbon, Spitzer, Williams & Benjamin, 1997) is a self-report screening measure used to assess broad personality disorder features. The SCID-II-SQ-BPD scale has been used in samples of adults and adolescents (age 15+) and has moderate overall sensitivity and specificity. The authors also reported good internal reliability (α = .88) and good test-retest reliability (Chanen et al., 2008).

The current study used the 15 item BPD subscale (example item: 'Have you often become frantic when you thought that someone you really cared about was going to leave you?') and was modified from the original 'yes/no' response option to measure symptoms dimensionally on a four-point response scale (0 = never or not at all, 1= sometimes or a little, 2 = often or moderately, 3 = very often or extreme) based on previous work with non-clinical samples (e.g., Bowles & Meyer, 2008; Dreessen, Arntz, Hendriks, Keune & van den Hout, 1999; Meyer, Ajchenbrenner & Bowles, 2005). Two self-harm related items were removed ('Have you tried to hurt

or kill yourself or threatened to do so?' and 'Have you ever cut, burned, or scratched yourself on purpose?') to avoid collinearity with the measure of self-harm leaving 13 items in the scale. Internal consistency for this version of the BPD subscale has been reported as good (α = .83, Meyer et al., 2005), and the 13-item version used in the present study was at least as reliable (α = .90).

The Short Coolidge Axis Two Inventory (SCATI – Coolidge, 2001) is also a self-report measure of personality disorder features. The five-item BPD scale was used (example item: 'I am very afraid of being abandoned by someone'), and participants responded on a four-point scale (strongly false, more false than true, more true than false, strongly true). There is one self-harm related item on the scale ('I have repeatedly made suicidal threats or gestures, or I have repeatedly hurt myself on purpose'), which was removed prior to analyses to again avoid collinearity with the self-harm measure leaving four remaining items which demonstrated acceptable internal consistency in the current study (α = .70).

The Personality Assessment Inventory (PAI - Morey, 1991) is a self-administered scale used for clinical assessment of adults. The borderline features scale (PAI-BOR) includes four subscales: affective instability, identity problems, negative relationships and self-harm. The self-harm subscale was removed from analyses, and internal consistency for the remaining 18 items was good (α = .84).

The total raw scores on the PAI can be converted to a T-Score based on normative data and uses T-scores that have a mean of 50 and a standard deviation of 10. Individuals with scores < 60T are considered to have fairly healthy personality dimensions. Scores of 60 – 69T represent a moderate elevation and may indicate tendency to anger and dissatisfaction. Scores of 70T and above are indicative of problematic symptoms in interpersonal relationships and impulsivity. Scores greater

that 90T are generally seen only in clinical samples and indicate markedly elevated symptoms, possibly an individual in crisis.

PAI-BOR T-scores for the no self-harm group ranged from 37 – 90 (M = 60.47, SD = 10.27) representing moderate elevation of personality traits, which is consistent with other non-clinical samples (e.g., Gardner & Qualter, 2009; Trull, 1995). Forty two participants (18.83%) had T-scores of 70 or above, which is considered the cut-off point that indicates presence of significant BPD features (Trull, 1995). T-Scores for the prior self-harm group ranged from 45 – 100 (M = 73.42, SD = 12.50), which is consistent with T-scores observed in clinical BPD samples (e.g., Jacobo et al., 2007). Seventy two participants had T-scores of 70 or above, likely reflecting problematic elevation of BPD features and indicating that individuals in non-clinical samples may show relatively high levels of borderline PD traits. T-scores differed significantly between the prior self-harm group and the no self-harm group (U = 5602, Z = -8.65, $p < .001$).

8.3.2.3 Measure of affect.

Negative affect is an important component of BPD (e.g., criterion 6 of the disorder is affective instability) and self-harm (Brown et al., 2002). In addition, there is evidence that EFs may be particularly impaired in BPD when in a state of negative affect (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009), it is necessary to include some measure of affect in order to examine the role it plays in these relationships. The Positive and Negative affect schedule (PANAS) (Watson, Clark, & Tellegan, 1988; see also Appendix B. 6) is the most widely used dimensional measure of trait and state affect (Tuccito, Giacobbi, & Leite, 2009). Positive affect (PA) refers to the extent that a person feels enthusiastic and alert, high PA is a pleasurable state of high energy and concentration while low PA is a

state of sadness and lethargy. Similarly, negative affect (NA) refers to distress and aversive mood states such as anger and guilt, so a state of low NA results in calmness and serenity. Positive and negative affect are generally believed to be orthogonal constructs (two distinct, but correlated factors) (Crawford & Henry, 2004). The PANAS consists of two ten-item scales measuring both positive (e.g., 'enthusiastic', 'proud') and negative (e.g., 'irritable', 'nervous') affect, and participants rate to what extent they generally experience each item within a specified time frame on a five-point response scale ranging from 'not at all' to 'extremely'. The 'past week' is the time frame used most frequently in clinical research (Crawford & Henry, 2004), but regardless of the time frame used (e.g., today, past 6 months, generally) both scales have good internal reliability ($\alpha > .8$, Watson et al., 1998). Subsequent studies have validated the PANAS in large normal populations (Crawford & Henry, 2004) and adolescents (Huebner & Dew, 1995) and suggest it provides adequately reliable and valid measures of both positive and negative affect. Data from the current study showed high internal consistency for negative and positive scales (both $\alpha = .92$).

8.3.2.4 Self-harm measure.

The Deliberate Self-Harm Inventory (DSHI - Gratz, 2001) is a 17-item self-report questionnaire developed to measure frequency, severity and type of self-harming behaviour. Participants' rate how often they have intentionally engaged in each of the 17 behaviours (e.g., 'Have you ever intentionally, on purpose, cut your wrist, arms, or other areas of your body without intending to kill yourself? If yes, how many times have you done this?'). The DSHI has demonstrated good initial internal consistency ($\alpha = .82$), and adequate test-retest reliability ($\Phi = 68$, $p < .001$) over a two to four week period. Subsequent research has confirmed the internal

consistency (α = .81, split-half r = .92) and good test-retest reliability (r = .91) of the DSHI, and in addition it demonstrated a higher sensitivity to detect self-harm compared to a similar self-report measure and a clinician administered measure (Fliege et al., 2006). Following completion of the measures, participants were encouraged to comment on their participation in the study (e.g., 'Do you have anything you would like to add that was not asked about in this questionnaire?'). A number of participants reported they had difficulty estimating the number of times they had engaged in each of the behaviours, therefore using total number of self-harm injuries as a variable proved to be problematic. Consequently, the DSHI was used to distinguish between participants who self-harmed and those who did not.

8.4 Results

8.4.1 Descriptive statistics.

There were 117 (34.41%) participants that reported previous self-harm; Table 8.1 displays the differing types of self-harm and the percentage of participants who endorsed the behaviour. Cutting and carving the skin are the most commonly used methods reported by participants, followed by burning, which is generally consistent with the literature (Klonsky, 2007). Note that some participants chose the 'prefer not to answer' option for some of the behaviours. The miscellaneous self-harm behaviours reported ranged from starving oneself as a punishment, exercising to exhaustion, and in one case injecting bacterial cultures into the skin.

Table 8.1 Types of Self-harm Reported

Type of self-harm behaviour	Number of Ps who have used this method (n = 117)
Cutting	98 (83.76%)
Carving words	45 (38.46%)
Carving pictures/designs	33 (28.21%)
Burning	30 (25.64%)
Cigarette burn	28 (23.93%)
Miscellaneous	23 (19.66%)
Interfering with wounds	15 (12.82%)
Scratching	12 (10.26%)
Head banging	7 (5.98%)
Sticking needles/sharp objects into skin	6 (5.13%)
Broken bones	6 (5.13%)
Bleach/chemical burns	5 (4.27%)
Biting	3 (2.56%)
Punching self	3 (2.56%)
Rubbing sandpaper on the skin	2 (1.71%)
Rubbed glass into the skin	1 (.85%)
Applied acid to the skin	0 (0%)

Items relating to self-harm behaviours were removed from BPD scales to avoid collinearity with the outcome measure. Given that the three BPD scales were measuring the same underlying construct, and the correlations between the measures were moderate to large in magnitude (r's = .56 - .84), a composite variable representing BPD features was created, in order to provide more reliable measures (e.g., Cheavens et al., 2005; Sprague & Verona, 2010). Individual scores were standardised (Z-transformed) and then summed in order to create an overall index of BPD features. This standardised BPD scale with the self-harm related items removed demonstrated good internal consistency (35 items, α = .93).

Table 8.2 Descriptive Statistics for Measures of Affect, BPD Features and Attentional Control

Measure		Prior self-harm (n = 117)	No self-harm (n = 223)	
	Min- Max	Mean (*SD*)		Sig
Negative Affect	10 - 49	28.79 (8.79)	24.53 (9.25)	$t(338) = -4.11^{**}$
Positive Affect	10 - 48	26.17 (8.26)	29.28 (9.08)	$t(338) = 3.10^{*}$
Focusing	9 - 36	22.15 (4.19)	21.48 (4.68)	$t(338) = -1.31$
Shifting	6 - 24	14.47 (2.54)	16.37 (3.16)	$t(338) = 5.61^{**}$
Flexibility	5 - 20	11.17 (2.24)	11.84 (2.93)	$t(338) = 2.17^{*}$
Combined BPD Scale (Z scores)	-6.78 - 6.34	.51 (.83)	-.33 (.76)	$t(338) = -9.39^{**}$

$^{*}p < .05$. $^{**}p < .001$.

Table 8.2 shows descriptive data for measures used in the current study by self-harm group (prior self-harm vs. no self-harm). Individuals who reported previous self-harm had significantly higher scores on BPD features and negative affect, and significantly lower scores on positive affect, shifting, and flexibility compared to the non-self-harm group.

Table 8.3 Correlations Between Self-report Measurement Scales

	(1)	(2)	(3)	(4)	(5)
(1) Negative affect	_				
(2) Positive affect	-.24**	_			
(3) ACS - Focusing	-.14*	.19**	_		
(4) ACS - Shifting	-.10	.22**	.48**	_	
(5) ACS - Flexibility	-.20**	.36**	.32**	.35**	_
(6) BPD features	.71**	-.42**	-.07	-.10	-.23**

Note: ACS = Attentional control scale; BPD features = Combined borderline scales
$^{*}p < .05$. $^{**}p < .001$.

Table 8.3 shows correlations between the scales used in the current study. Results of Pearson's correlational analyses showed that ACS subscales were

generally weak to moderately correlated, indicating that ACS subscales indexed some shared processes. Negative affect scores correlated with BPD features, and negatively correlated with all three of the ACS subscale scores in the prior self-harm group, whereas it was positively correlated with focusing and shifting in the no self-harm group. The flexibility subscale scores of the ACS correlated negatively with BPD feature scores, suggesting low flexibility ability in the presence of BPD features. BPD features scores also correlated with negative affect, and inversely with positive affect.

8.4.2 Inferential statistics.

A hierarchical logistic regression model was used to examine possible contribution of affect, BPD features, and attentional control to the probability of reporting previous episodes of self-harm (see Table 8.4). Self-harm was, therefore, the criterion variable. It was decided that a binary variable simply indicating whether individuals had ever engaged in self-harm was most appropriate. The variable was coded 1 to indicate prior self-harm and 0 to indicate no prior self-harm. Affect (as measured by the PANAS) was entered in the first block due to the important role negative affect plays in self-harm behaviour. The BPD variable was entered in the second step to examine whether BPD features predicted self-harm likelihood separately from affect. The attentional control variables (focusing, shifting, and flexibility) as measured by the ACS were entered in the final step of the regression to examine whether deficits in specific components of attentional control would partially explain the association between BPD and self-harm.

Table 8.4 Hierarchical Logistic Regression Testing Main Effects of Affect; Attentional Control; and BPD Features on Prior Incidence of Self-harm

	R^2 R^2_a - R^2_b	Odds Ratio	95% CI Lower, Upper
Step 1	.06 - .08		
Negative Affect		1.05*	1.02, 1.07
Positive Affect		0.97*	0.94, 0.99
Step 2	.22 - .31		
Negative Affect		0.94*	0.91, 0.98
Positive Affect		1.01	0.98, 1.04
BPD		5.99**	3.64, 9.88
Step 3	.34 - .47		
Negative Affect		0.94*	0.90, 0.99
Positive Affect		1.02	0.99, 1.06
BPD		7.51**	4.26, 13.25
Focusing		1.20**	1.11, 1.30
Shifting		0.66**	0.58, 0.75
Flexibility		1.04	0.93, 1.18

Note: Pseudo R-Squareds are R^2a = Cox and Snell, R^2b = Nagelkerke, respectively. *$p < .05$. ** $p < .001$.

The full model containing all predictors was significant (χ^2 (5) = 140.79, p = < .001) compared to the constant only model, indicating that the full model distinguished between participants who reported instances of self-harm and those who did not. The model as a whole explained between 34% (Cox & Snell R^2) to 47% (Nagelkerke R^2) of the variation in self-harm and correctly classified 80.60% of cases. There were six independent variables at the final step, four of which made a unique and significant contribution to the probability of reporting self-harm. (See Table 8.4).

In the final step of the regression odds ratios indicated that BPD features most strongly predicted likelihood of self-harm, and no mediating effects of the added attentional control variables were indicated. Focusing and shifting variables were associated with prior self-harm likelihood. Higher shifting scores were associated with lower rates of self-harm, and focusing appeared to have a positive association with self-harm. These associations were independent of BPD and raise the

possibility that they may interact with BPD features in their association with self-harm. The positive association between self-harm and focusing is in the opposite direction to that shown in simple t-tests (Table 8.2), and may suggest a suppressor effect of either affect or BPD that is only apparent when analysed together in a regression. Alternatively, there may an interactive effect of BPD and focusing, and this, along with a similar interaction between shifting and BPD was explored.

To do this, interaction terms were created as the products of standardised (Z-transformed) versions of the BPD variable and the focusing and shifting variables. The interactive effects of BPD and focusing ability and of BPD and shifting ability were tested in two separate hierarchical logistic regressions. In each regression the two predictor variables were entered in the first step, and the interaction term was entered into the second. In both cases the interaction terms were uniquely significant (see Tables 8.5 and 8.6).

Table 8.5 Hierarchical Logistic Regression Testing Interaction Effects of BPD Features and Focusing on Prior Incidence of Self-harm

	R^2 R^2_a - R^2_b	Odds Ratio	95% CI *Lower, Upper*
Step 1	.21 - .29		
BPD		3.85**	2.72, 5.45
Focusing		1.35*	1.03, 1.75
Step 2	.25 - .34		
BPD		4.21**	2.86, 6.20
Focusing		1.18	.89, 1.58
BPD X Focusing interaction		2.01**	1.40, 2.88

Note: Pseudo R-Squareds are R^2a = Cox & Snell, R^2b = Nagelkerke, respectively.
*$p < .05$. ** $p < .001$.

Table 8.6 Hierarchical Logistic Regression Testing Interaction Effects of BPD Features and Shifting on Prior Incidence of Self-harm

	R^2 R^2_a - R^2_b	Odds Ratio	95% CI *Lower, Upper*
Step 1	.26 - .37		
BPD		3.68**	2.62, 5.16
Shifting		.46**	.34, .62
Step 2	.28 - .39		
BPD		4.63**	3.07, 6.98
Shifting		.45**	.33, .62
BPD X Shifting interaction		1.75*	1.19, 2.59

Note: Pseudo R-Squareds are R^2a = Cox and Snell, R^2b = Nagelkerke, respectively.
*$p < .05$. ** $p < .001$.

Plots were created to help interpret the interactions. The plots indicate that those two attentional control factors differentially moderated the association between BPD and rates of self-harm. For individuals low in BPD, high focusing ability appears to reduce the risk of self-harm, yet increase the risk for those high in BPD features (see Figure 8.1). One possibility is that focusing is a protective factor for some, and a rumination-like risk factor for others. The picture with shifting ability is somewhat different. The plot suggests that for those with pronounced BPD features shifting ability has little bearing on self-harm risk (see Figure 8.2). However, among those individuals with few BPD features, reduced shifting ability may pose a slightly elevated self-harm risk.

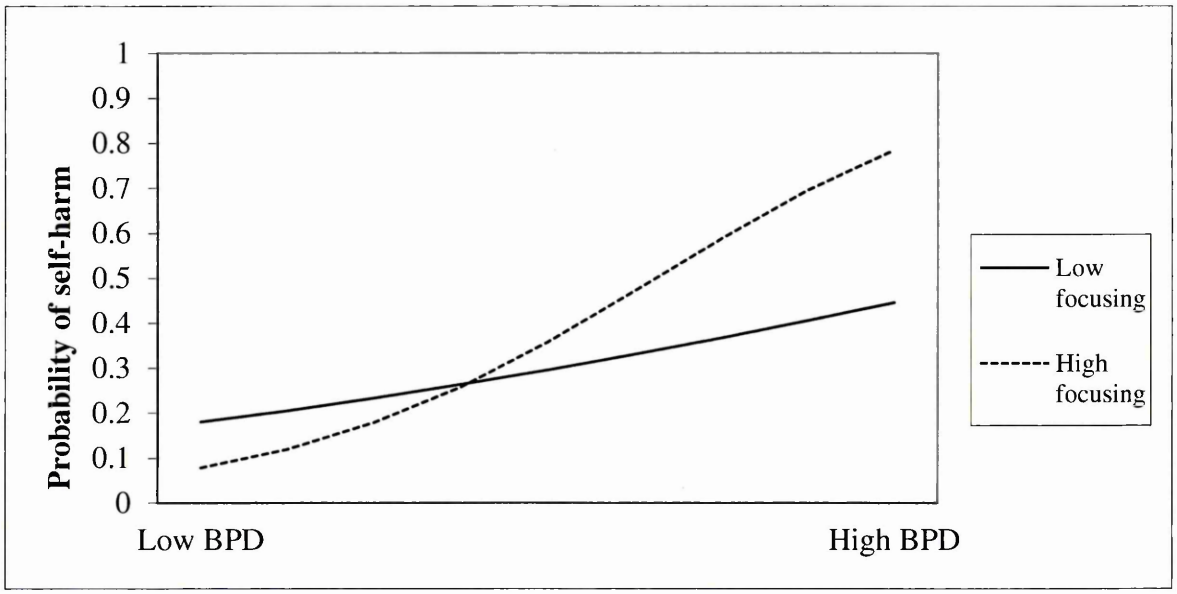

Figure 8.1 Interaction of BPD and Focusing ability on likelihood of prior self-harm.

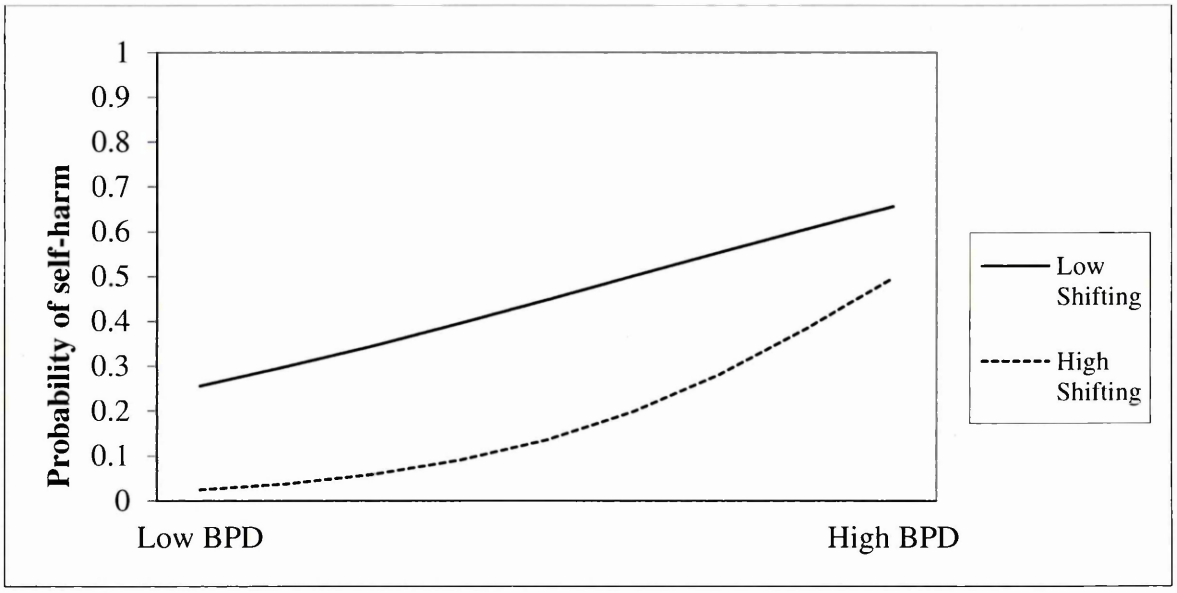

Figure 8.2 Interaction of BPD and Shifting ability on likelihood of prior self-harm.

8.5 Discussion

The current study investigated the relationships among BPD features, three aspects of attentional/executive control (shifting, focusing and flexibility), affect, and self-harm in a large non-clinical sample. The hierarchical logistic regression showed that BPD ratings and attentional focusing predicted self-harm incidence, although the

pattern of data was not entirely as anticipated with high attentional focusing scores increasing the likelihood of a prior self-harm history in those rating high BPD features. The ability to shift attention was associated with a reduced likelihood of self-harm.

As hypothesised, high BPD scores were associated with greater likelihood of an individual reporting previous self-harm. The findings demonstrate the importance that BPD features play in propensity to self-harm in a non-clinical sample. There is evidence that individuals drawn from non-clinical populations with high levels of BPD features show social and occupational problems along with impaired executive function ability compared to those with few or no BPD features (Ayduk et al., 2008; Fossati et al., 2004; Trull, Widiger, & Guthrie, 1990). Most research with BPD groups has centred on those with a clinical diagnosis meaning that less is known about how BPD features might drive maladaptive behaviour in non-clinical groups. The findings reproduce the strong association shown between BPD features and self-harm likelihood in clinical cases indicating that despite possible differences between clinical and non-clinical BPD there are also some shared processes that potentially transcend a BPD diagnosis in relation to self-harm. Most psychiatric disorders can be considered on a continuum from complete absence of symptoms, for example in remittance, to clinically severe (Tyrer, 2009). The findings also support the dimensional approach to psychiatric disorders and illustrate the importance of investigating functions in a range of participants who may present along the BPD spectrum.

The results showed that high focusing ability reduced self-harm likelihood for individuals low in BPD features but increased the risk for those rating themselves highly on BPD features. Thus, when high BPD features are present a good capacity

to focus attention is likely directed in some maladaptive way. BPD features also correlated with negative affect: these findings raise the possibility that high focusing might manifest as ruminative perseverative thought patterns that influence behaviour and affect. What is not clear is whether high focusing is targeted at potential self-harming behaviour or instead functions to precipitate self-harm. The former is more plausible because self-harmers tend to report immediacy and urgency when self-harming that is then followed by catharsis. Arguably, it might be the case that high focusing ability functions to maintain some BPD features. Key features of BPD measured by the composite scale include fluid sense of the self, emotional instability, feelings of and expression of rage, fear of abandonment, unstable but intense relationships and impulsivity. Thus, intenseness of relationships for example might be a consequence of over-focusing on the other, and also over-focusing on the possibility of abandonment. Likewise exaggerated anger responses might arise due to over-focusing on perceived slights or suspected indications of future abandonment. In addition, the finding that low flexibility in attentional control is associated with high BPD features supports the notion the high focusing might drive and/or maintain perseverative and anxiety inducing cognitions that ultimately lead to self-harm because the individual cannot switch attention 'off topic.' High levels of focusing in people with low BPD feature ratings may protect against self-harm risk by enabling the individual to override prepotent and maladaptive thought patterns.

Present findings indicate that attentional shifting ability had little bearing on self-harm risk in those who rated themselves high on BPD features. This finding corresponds well to the notion that those high in BPD features may be highly focused upon thoughts that precipitate negative affect and self-harm. Thus, a pattern of relationships emerges whereby the 'maintaining' function of high focusing

makes most demand on capacity constrained attentional resources in those with high BPD features, at the expense of attentional flexibility and attentional switching. The findings also show an association between low attentional shifting ability and slightly elevated self-harm risk for those individuals with few or no BPD features. Attentional shifting is not a unitary process: ability to reallocate capacity-constrained attentional resources to a different intrinsic or extrinsic stimulus depends upon inhibition of earlier focus. Thus, inhibitory capacity will affect attentional shifting ability, when reduced it should make attentional switching difficult due to resource competition. In addition, emotional stimuli have been shown to be more resistant to inhibition than non-emotional stimuli (Schulz et al., 2007), and this may be particularly salient for those high in BPD features. There is also some suggestion that low inhibitory ability and high urgency may mediate rash behaviour across a range of groups and disorders (Gay, Rochat, Billieux, d'Acremont & Van der Linden, 2008). Consequently, good attentional switching ability may provide a protective buffer against self-harm behaviour for some individuals by reducing the likelihood of pathological focusing and perseverative thought patterns (Judah, Grant, Mills, & Lechner, 2013).

Individuals may self-harm for a variety of reasons including reducing negative affect and arousal, as an anti-dissociation mechanism (also referred to as 'feeling generation'), as a way of avoiding suicide, reinforcing personal boundaries, as self-punishment, or as a method of sensation seeking (Klonsky, 2007). Within this framework anti-dissociation refers to capacity of self-harm to ameliorate sense of depersonalisation in BPD (APA, 2013; Klonsky, 2007), and is generally considered to be distinct from the graver and psychotic disconnect from reality defined as 'dissociation' in other disorders such as schizophrenia and Bipolar Disorder.

Although the current study did not include a specific measure of social functioning, the literature suggests self-harmers have significantly worse physical and social functioning and reduced quality of life compared to non-self-harmers in the general population (Sinclair, Hawton, & Gray, 2010). This includes a significant and persistent risk of suicide 15 years after presenting at hospital with a self-harm injury (Hawton et al., 2003). However, it is important to note that in the current study, the sample of participants likely consisted of relatively higher-functioning individuals, as participants were not recruited from mental health services or hospitals, which are typical treatment sites for lower functioning individuals with a BPD diagnosis (Sansone et al., 1998). Despite this, participants did endorse a high number of BPD features, particularly in the self-harm group. Research suggests that high BPD features (e.g., individuals who score above the clinically significant cut-off point of 70T on the PAI-BOR) are associated with poorer outcomes such as academic difficulties, meet criteria for a mood diagnosis, and experience interpersonal dysfunction, even within a nonclinical population (Trull et al., 1997).

The development of adaptive flexible attentional control might pose a potentially useful therapeutic goal for those high in BPD features. Mindfulness refers to the practice of non-reactive attention to the present moment, focusing on thought, emotions and bodily sensations as well as environmental stimuli (sounds and smells) even if they are unwanted or unpleasant whilst accepting their impermanence (Linehan, 1993). Increased mindfulness skills appear to improve psychological functioning by cultivating an adaptive form of self-focused attention that reduces rumination and emotional avoidance, and improves behavioural self-regulation (Baer, 2009; Selby et al., 2009; Lynch et al., 2006). This may be a fruitful area for future work in non-clinical self-harming groups.

BPD is also known to share some affect regulation and impulse control features with attention-deficit/hyperactivity disorder (ADHD) and ADHD may be comorbid with BPD (Philipsen, 2006). Additionally, ADHD may be a risk factor for the development of BPD in adulthood (Philipsen et al., 2008). However, it is possible that attentional control problems may underlie both conditions, constituting the shared processes of each condition, and that the emergence of one disorder rather than the other, or one main disorder with ADHD co-morbidity, is driven by the selective constellation of personality, developmental and familial factors combined with attentional control problems. Future work might explore the potential shared contribution of executive/attentional control problems to personality disorders and co-morbid conditions.

8.5.3 Limitations.

A limitation of the current study was the use of self-report measures of attentional control, although other work also indicates that ACS scores are associated with behavioural and neurophysiological indicators of executive control (e.g., Derryberry & Reed, 2002). It is possible that subjective reports differ about attentional control are not similar from objective indices of attentional control (Verwoerd et al., 2008). Consequently, ongoing work (Study 2) is developing new experimental paradigms and using a comprehensive raft of standardised cognitive tests to investigate these assumptions and further tease apart the putative relationship between executive control and self-harm likelihood. Present findings support the notion of a multi-componential executive system by demonstrating different patterns of relationship among attentional variables on likelihood of self-harm in those with BPD features. Of note, those high in BPD features showed high focusing scores indicating no impairment in this capacity as anticipated, although

flexibility and shifting scores were significantly lower in those with a self-harm history compared to non self-harmers. This finding seems to indicate that it is the content of attentional focusing rather than the process that may be pathological in those high in BPD features.

Another potential limitation is the use of self-referring participants. Although it was a non-clinical sample of participants, 28% of the sample reported a previous history of self-harm, much higher than the 4% prevalence rate in the general population, and higher than the 21% prevalence rate typically found in a clinical sample (Briere & Gil, 1998). This may reflect a self-selection bias due to participants being attracted to the study because of the nature of the topic. However, given that individuals who self-harm are typically considered a difficult group to engage in research (Hawton & Sinclair, 2003; Clarke et al., 2004), the online methodology used in the current study proved to be an effective way of targeting this population. In addition, participants did endorse a high number of BPD features, particularly in the self-harm group. T-scores reflected that a number of participants in both the self-harm and non self-harm group reached the clinical cut-off point for a diagnosis of BPD. These findings indicate that individuals in non-clinical samples may show relatively high, and problematic, levels of borderline PD traits.

This is again consistent with the current view of personality disorders and psychopathology in general, which is moving towards a more dimensional approach (APA, 2013) which posits that most psychiatric disorders can be placed on a continuum between a complete absence of symptoms to extreme symptoms, (Tyrer, 2009) and that meaningful results can be found beyond simply categorising individuals by presence or absence of a PD diagnosis (Fossati et al., 2004; Trull et

al., 1990). Never the less, it is unclear to what extent these findings can be generalised to clinical populations with BPD and the wider, general population.

8.6 Summary and Conclusions

To summarise, the current study used an online method of data collection to explore the putative relationship among levels of BPD features, three aspects of attentional/executive control, affect, and self-harm history. A total of 340 non-clinical participants were recruited online from self-harm forums and social networking sites. Participants completed a number of self-report measures of attentional control, affect, and a number of BPD measures.

Preliminary analyses showed that types of self-harm reported were consistent with the literature, with cutting, carving, or burning the skin the most commonly reported behaviours. However, there was a higher prevalence rate of self-harm than reported in the previous literature, however this may be due to a self-selection bias by participants. A limitation of the current study was the use of a self-referring, non-clinical sample of participants. However, levels of BPD features were generally consistent with those previously reported in both clinical BPD samples and non-clinical samples. This supports the current dimensional approach to psychiatric disorders and psychopathology, and the notion that meaningful results can be obtained from non-clinical samples. This also suggests that the online method of data collection used in the present study was an effective method of targeting what is thought to be traditionally a difficult group to engage in research (Hawton & Sinclair, 2003; Clarke et al., 2004). Limitations of the current study include reliance on self-report measures, particularly the measure of attentional control, as it could be argued that subjective reports of attentional control differ from objective measures.

This is an issue that will be addressed in study 2, by introducing a number of standardised and validated executive function measures.

Further analyses showed that self-reported levels of BPD features and attentional focusing predicted self-harm incidence, and high attentional focusing increased the likelihood of a prior self-harm history in those with high BPD features. Ability to shift attention was associated with a reduced likelihood of self-harm, suggesting that good attentional switching ability may provide a protective buffer against self-harm behaviour for some individuals. These attentional control differences mediated the association between negative affect and self-harm, but the relationship between BPD and self-harm appears independent. These findings support the notion of a multi-componential executive system by demonstrating different patterns of relationship among attentional variables on likelihood of self-harm in those with BPD features. Of note, those high in BPD features showed high focusing scores indicating no impairment in this capacity as anticipated, although flexibility and shifting scores were significantly lower in those with a self-harm history compared to non self-harmers. This finding seems to indicate that it is the content of attentional focusing rather than the process that may be pathological in those high in BPD features.

The high incidence of self-harm cases reported each year beyond psychiatric groups suggests a need for improved pathways to diagnosis and treatment for those who self-harm. The data indicate that BPD features might play a role in mediating these behaviours and also that attentional control factors, as measured by the variables also contribute to self-harm likelihood. Overall, the findings indicate that personality and attentional control factors interact to determine self-harm likelihood whereby high attentional focusing and shifting abilities are protective when BPD

features are low but high focusing may be a possible maintaining factor when BPD features are high. The link between self-harming and executive/ attentional deficits has to date poorly been investigated, the current study addresses the gap in the research and future work will hopefully begin to clarify the putative relationship between executive control and self-harm.

Chapter 9 Study 2 - Borderline Personality Features and Self-harm: Executive Functions and Adult Attachment and Mediators and Moderators

9.1 Overview of the Study

To address some of the limitations of the previous research, study 2 will use a wider variety of executive function measures alongside the ACS, specifically measures that tap cognitive fluency, inhibition, problem solving, and shifting of attentional sets. This is to capture the dynamic and multi-componential nature of the EFs and to further examine the role they play in self-harm and BPD features. Attachment theory was proposed as a useful theoretical framework for understanding both the development of individual differences in EFs, and the aetiology and maintenance of self-harm and BPD features. Alongside a self-report measure of adult attachment, an experimental vignette approach (Atzmuller & Steiner, 2010) will be used to study the extent to which intent to self-harm might vary as a function of attachment insecurity and social cognition.

Analysis showed increased levels of BPD features and attachment insecurity in the self-harm group compared to controls. There was also evidence of executive function deficits in the self-harm group, since they demonstrated poorer problem solving skills and a persistent inability to disengage from stimuli and switch cognitive sets. There was also evidence of social cognitive deficits in the self-harm group, since they reported significantly lower self-esteem and an increase in intent to self-harm after exposure to the abandonment and rejection related vignettes. Furthermore, self-esteem functioned as both a mediator and a moderator of the relationship between BPD and self-harm. Supplementary material for Study 2 is included in Appendix D.

9.2 Linking Study 1 to Study 2

The findings from Study 1 reproduced the strong association shown between BPD features and self-harm that is often reported in the literature (e.g., Lieb et al., 2004; Whitlock et al., 2006; Zanarini et al., 2008). Additionally, the findings indicated that attentional control may play a role in self-harm and BPD features. Specifically, high attentional focusing and shifting abilities are protective when BPD features are low, but high focusing may be a possible maintaining factor when BPD features are high. It was argued that this might reflect ruminative perseverative thought patterns, or 'over-focusing' on negative emotions, and difficulty inhibiting and shifting attention away from negative emotions. As a result, individuals may resort to self-harm as a way to relieve this negative affect. To address some of the limitations of study 1, the current study will use a combination of standardised executive function tests alongside the self-report measure of attentional control to further tease apart the relationship between executive functions and self-harm.

It is also proposed attachment organisation as a possible mediator or moderator of the relationship between BPD traits and self-harm. There are theoretically relevant associations among attachment orientation and the variables of interest, attachment is strongly associated with BPD features (e.g., Clarkin et al., 2007; Levy, 2005; Meyer & Pilkonis, 2005), social cognition (Lazarus et al., 2014), self-harm (Suyemoto, 1998), and neurocognitive development (Schore, 1996). The development of executive functions depends heavily on brain maturation and can be influenced by attachment related behaviours in early life (Bernier, Carlson, & Whipple, 2010). Furthermore, findings from the pilot study (see Appendix D.5) found that attachment anxiety functioned as a mediator of the relationship between BPD features and overall vignette ratings. Therefore, attachment theory is an appropriate

theoretical framework that may help to increase understanding of how EFs are related to the aetiology and maintenance of BPD features and self-harm via social cognition.

9.3 Introduction

Although executive function deficits have been linked to BPD symptoms, it is in relatively general and unspecific terms (see section 4.2 for a discussion of executive functions in BPD and self-harm). EFs are a complex collection of processes, and research is only just beginning to untangle the relationship between particular EFs and BPD symptomology. Individuals with BPD show an inability to disengage attention from emotional stimuli, particularly in negative emotional conditions (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009). They also exhibit consistent difficulties with response inhibition (Black et al., 2009) and poor decision making (LeGris et al., 2012). Dissociative symptoms may have particular importance, as in one study BPD patients who dissociated were deficient in every cognitive domain, while the BPD group without dissociative symptoms only exhibited deficits in EFs (Haaland & Landrø, 2009). This suggests that more severe symptoms of BPD may be related to more severe cognitive deficits.

There is little to no research that focuses specifically on the neuropsychological basis of self-harm outside of a BPD diagnosis. Findings from Study 1 indicated that self-reported attentional control factors and BPD features interact to influence self-harm likelihood, consequently the current study will further investigate this relationship and will address some of the limitations of the previous study, namely self-report measures of attentional control, by using a wider range of EF tasks. Selection of the EF tasks was guided by previous literature, and tasks

were chosen that measured the EF components of shifting (of attentional sets), cognitive flexibility, response initiation, response inhibition, and problem solving.

Individuals with high BPD features tend to ruminate on negative emotions, possibly because they are unable to effectively inhibit or switch their attention away from negative emotional distress (Lenzenweger et al., 2004). Therefore BPD pathology may be linked to an inability to disengage attention, which is particularly heightened if the individual is in a negative mood (von Ceumern-Lindenstjerna et al., 2009). Shifting of attentional sets has been showed to be impaired in BPD on behavioural tasks such as the Wisconsin Card Sorting Task (WCST; Heaton, Chelune, Talley, Kay, & Curtis, 1993) (Lenzenweger et al., 2004), as they show significantly more perseverative responses and perseverative errors (uncontrollable repetition of a response without appropriate stimuli) compared to controls. In addition, poor cognitive flexibility (as measured by a verbal fluency task) has been shown to be related to poor emotional regulation abilities, and can predict emotion regulation ability across a range of stimuli (e.g., startle response, film clips) and emotions (e.g., disgust, amusement), with higher verbal fluency performance predicting more successful regulation of emotional responses (Gyurak et al., 2012a). Cognitive rigidity may also reflect difficulties with suppressing/inhibiting dominant or automatic responses, as inhibition deficits have consistently been reported in BPD (Ayduk et al., 2008). Furthermore, response inhibition, as measured by Stroop interference, has also been closely linked to suicidal ideation and suicide risk in BPD (LeGris et al., 2012).

Temporary reductions of EFs by situational factors, such as perceived rejection or interpersonal difficulties, are also likely to contribute to self-harm in BPD since EF deficits appear to be particularly compromised during negative emotional

conditions (von Ceumern-Lindenstjerna et al., 2009). As discussed in Study 1, this suggests that it may be the content of attentional focusing rather than the process that may be pathological in those high in BPD features. This is consistent with the emotional cascade model of self-harm in BPD (Selby et al., 2008; 2009), in which individuals cannot distract attention away from their negative affectivity, and subsequently cannot inhibit ruminating on it. It is also consistent with Linehan's (1993) biosocial model of BPD in which emotional dysregulation is at the core of the disorder. Consequently, deficiencies in EFs most likely contribute to BPD symptoms, and it seems plausible that these deficits, in particular inhibition, contribute to self-harm behaviour in BPD. However, this is so far speculative as research has generally neglected to explore the role of executive cognition in self-harm outside of the context of BPD.

9.3.1 Social cognition and attachment.

A possible explanation for the findings of EF deficits in BPD and self-harm, and the fact they appear to be particularly compromised during negative emotional conditions, can be provided by attachment theory. Attachment experiences in infancy shape the early organisation of the right brain, influencing the development and organisation of cortical and limbic areas that are critical to self and emotion-regulation (Schore, 1994; 2001; 2003a; 2003b). Research suggests that attachment experiences in adolescence exert a similar effect (Moretti & Peled, 2004). Both insecure attachment and self-harm are associated with the inability to manage anger and failure to self-regulate emotions (Suyemoto, 1998). Gratz et al. (2002) found that an insecure attachment to a parental figure in childhood was significantly related to lifetime self-harm rates. A study looking at adult attachment and self-harm found that romantic attachment characterized by high anxiety over abandonment

influenced the prevalence of recent self-harm related thoughts (Levesque et al., 2010).

Internal working models (mental representations) of the self and others are central to understanding cognitive processes in personality disorder (Bowles & Meyer, 2008, Meyer & Pilkonis, 2005). Negative internal working models may produce negative social cognitive biases, and deficits in social cognition (i.e., encoding, interpretation, and processing of information pertaining to the self and others) have been identified as important contributing factors to self-harm (Williams et al., 2015). Consequently some researchers have argued that social cognition may be the mechanism by which attachment orientation influences BPD features and self-harm (Williams et al). Self-esteem appears to be an important social cognitive variable, as individuals with BPD possess unstable low self–esteem (Ziegler-Hill & Abraham, 2006), and individuals who self-harm have lower levels of self-esteem and higher self-criticism than non-injurers (Hodgson, 2004). Previous research has shown that self-criticism mediates the relationship between previous childhood abuse and self-harm in adolescence (Glassman et al., 2007), and self-esteem mediates the relationship between PD symptoms and self-harm (Cawood & Huprich, 2011). Taken together, this evidence suggests that attachment orientation and social cognition may contribute to self-harm.

The initial aim is to replicate findings from Study 1 and demonstrate that components of executive function along with BPD features will be associated with self-harm likelihood in a non-clinical sample. Specifically, it was hypothesised that those individuals who report previous self-harm will exhibit deficits in executive functions and higher levels of BPD feature compared to controls. In addition, it was also anticipated that EF deficits may mediate and/or moderate the association

between BPD features and self-harm. Furthermore, it was hypothesised that increased levels of attachment insecurity (avoidance and anxiety) in the self-harm group compared to controls, and also predicted that there will be social cognitive processing biases in the form of reduced self and other-esteem, and an increased likelihood of self-harm harm after exposure to the abandonment and rejection related vignettes. Finally, it was predicted that attachment organisation will mediate and/or moderate the relationship between BPD features and intent to self-harm after exposure to the vignettes.

9.4 Method

9.4.1 Participants.

Adult participants (aged 18 and above) were recruited primarily on the basis that they currently engage in self-harm type behaviours. Participants were a self-referring sample recruited via posters/flyers placed in appropriate organisations (e.g., YourVoice in Sheffield mental health magazine). The second wave of participants (the 'healthy control' comparison group) were mostly recruited from a student sample, via the Faculty of Development and Society PSYCREDS system, which rewards undergraduate students with research credits which fulfil part of the criteria of assessment for their research methods module. Control participants were matched for age and gender with the self-harm group of participants.

See Appendix D.2 for the Call for Participants flyer. A total of 46 participants were recruited, of which 6 (13%) were male, and ages ranged between 19 - 46 years, with a mean age of 21.54 (SD = 5.58), and 26 (56.52%) participants reported previous self-harm. Of these 26 participants, two reported a diagnosis of BPD, one was recovering from anorexia, and one reported multiple comorbidities (BPD, anorexia, and depression). The remaining 20 participants (43.48%) in the healthy

control (HC) group reported no previous experience of self-harm and no previously diagnosed mental health conditions. The age and gender breakdown for each group can be seen in Table 9.1 and age and gender did not meet parametric assumptions, therefore a Mann-Whitney U test was performed. As expected, there were no significant differences in age ($U = 226.00$, $Z = -.799$, $p = .42$) or gender ($U = 251.00$, $Z = -.342$, $p = .73$) between the self-harm group and the HC group.

Table 9.1 Gender and Age of Participants.

Self-harm group			Control group		
	Age range	Mean age (*SD*)		Age range	Mean age (*SD*)
Male ($n = 3$)	19 - 20	19.33 (.58)	Male ($n = 3$)	19 - 20	19.33 (.57)
Female ($n = 23$)	19 - 46	22.04 (6.09)	Female ($n = 17$)	19 - 44	21.65 (5.87)

9.4.2 Materials.

The current research project was approved by the University's Research Ethics Committee (see Appendix D.1 for ethical approval). Informed consent was obtained via a participant information sheet containing details of the study, issues of confidentiality and the right to withdraw, and an Informed consent checklist that the participant was required to sign (see Appendix D.3). All participants were debriefed upon completion of the study (see Appendix D.4 for the debriefing information). The current study used a mixture of self-report and researcher administered neuropsychological tests described in the following section.

9.4.2.1 Self-report measures.

As in study 1, attentional control was measured using The Attentional Control Scale (ACS) (Derryberry & Reed, 2002), which is a 20 item self-report measure of attentional control. The ACS (Fajkowska & Derryberry, 2010) has three subscales designed to tap the three dimensions of attention: attention focusing, shifting, and

flexibility. In the current study, the focusing subscale demonstrated good internal consistency (α = .70), and the shifting and flexibility subscale alphas demonstrated acceptable internal consistency for small scales (α = .61 and .50, respectively). The overall scale demonstrated high internal reliability (α = .79), and the Spearman-Brown split-half reliability coefficient for the overall ACS score was .70, which is generally considered acceptable – adequate for exploratory research.

Self-harm was measured using the Deliberate Self-Harm Inventory (DSHI - Gratz, 2001), which is a 17-item self-report questionnaire developed to measure self-harming behaviour. As in the previous study, a number of participants reported they had difficulty estimating the number of times they had engaged in each of the behaviours, the DSHI was used to distinguish between participants who self-harmed and those who did not.

Affect was measured using The Positive and Negative Affect Schedule (PANAS – Watson et al., 1988). Data from the current study showed high internal consistency for negative and positive scales (α=.91 for both).

The two attachment dimensions of anxiety and avoidance were measured using the 36-item Experiences in Close Relationships Questionnaire (ECR; Brennan, Clark, & Shaver, 1998). The ECR is a self-report questionnaire with a 7 point response scales ranging from 'Disagree strongly' to 'Agree strongly' that taps attachment avoidance (e.g., 'I prefer not to show a partner how I feel deep down') and attachment anxiety (e.g., 'I worry about being abandoned'). Both scales had good internal consistency, (.94 and .96 for anxiety and avoidance respectively), and good discriminant validity as the two scales were only moderately correlated (both subscales met parametric assumptions, Pearson's two-tailed $r = .36$, $p < .001$).

9.4.2.2 BPD measures.

As in study 1, BPD features were measured using both the PAI-BOR (Morey, 1991) and SCID-II-SQ (First et al., 1997). The SCATI (Coolidge, 2001) was not included in study 2 in order to reduce participant burden and because it was the least internally valid of the three borderline measures in study 1. The SCID-II-SQ was again modified from the original 'yes/no' response option to measure symptoms dimensionally on a 4-point response scale (0 = never or not at all; 1= sometimes or a little; 2 = often or moderately; 3 = very often or extreme) as in study 1, in order to capture the variance of BPD features (e.g., Bowles & Meyer, 2008; Dreessen et al., 1999; Meyer et al., 2005). The modified SCID-II-SQ had good internal reliability (α = .91, 15 items).

In the current study, the PAI-BOR demonstrated good internal consistency (α = .83, 24 items). PAI-BOR T-scores for the no self-harm group ranged from 49 - 81 (M = 60.35, SD = 10.10) representing moderate elevation of personality traits, which is consistent with other non-clinical samples (e.g., Gardner & Qualter, 2009; Trull, 1995). Four out of 20 (20%) participants had T-scores of 70 or above, which is considered the cut-off point that indicates presence of significant BPD features (Trull, 1995). T-Scores for the prior self-harm group ranged from 52 - 95 (M = 74.23, SD = 12.16), which is consistent with T-scores observed in clinical BPD samples (e.g., Jacobo, Blais, Baity & Harley, 2007). Out of the 26 participants in the self-harm group, 16 (61.54%) participants had T-scores of 70 or above, likely reflecting problematic elevation of BPD features.

9.4.2.3 Self and other-esteem measures.

Participants were asked to imagine themselves experiencing the situation depicted in the vignettes and then asked to rate their self and other esteem. A

single-item measure was used to tap self-esteem: "How would you feel about yourself in this situation?", and responses were scored on a six point Likert scale ranging from 'extremely positively' to 'extremely negatively'. This item was administered after each scenario and was designed to tap state self-esteem in such a way that it can be done repeatedly with minimum participant burden. Previous studies have shown that the single-item self-esteem measure correlates strongly with the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965), which is the most widely used measure of global self-esteem, and has good criterion validity (Bowles et al., 2013). Other-esteem was tapped using the same question as for self-esteem, but with the word 'yourself' replaced with 'your partner/friend' as applicable. The self and other esteem responses were combined across all six imaginary scenarios to form two six-item scales. The self-esteem scale had good alpha reliability (.81), but the other-esteem scale was less reliable (.50).

9.4.2.4 Intent to self-harm.

A single-item measure was used to tap intent to self-harm: 'How likely would you be to hurt yourself in this situation?' and responses were scored on a six point Likert scale ranging from 'Definitely would not' to Definitely would'. This item was also administered after each vignette. Although the best predictor of future self-harm is a previous history of self-harm (Janis & Nock, 2008; Lewis & Santor, 2010), previous studies have shown that individuals can accurately forecast their future risk of self-harm comparable to standard assessment tools, and that responses to a single question that taps self-perceived risk (e.g., 'How likely are you to hurt yourself?') significantly predicts proximate self-harm (Peterson, Skeem, & Manchak, 2011). The intent to self-harm responses was combined across all six vignettes to for an overall intent to self-harm scale which had good alpha reliability (.96).

9.4.2.5 Researcher administered tasks.

The behavioural tasks and the rationale for their selection are described in detail in section 6.2.3 but they are briefly summarised here.

The Delis-Kaplan Executive Function System (D-KEFS) (Delis, Kaplan, & Kramer, 2001) is a battery of nine neuropsychological tests for both children and adults, designed to tap key executive functions such a higher-level thinking and cognitive flexibility. The current study used the verbal fluency, design fluency, and sorting tasks.

The Hayling Sentence Completion task developed by Burgess and Shallice (1997) requires participants inhibit an automatic response in order to generate an appropriate one and provides a measure of both initiation speed and response suppression, thereby tapping the ability to shift attentional sets.

The Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999) is a reliable and easy to administer brief measure of intelligence, which can be used with individuals aged 6 - 90 years of age (McCrimmon & Smith, 2013). The WASI can be used to provide a measure of verbal IQ, performance IQ, and an estimate of full-scale IQ.

The Emotional Stroop task is based on the Stroop paradigm (Stroop 1935), but has been modified to specifically use attachment-related stimuli, specifically positive (e.g., adore) and negative (e.g., abandon) attachment-related words. A detailed description of the attachment-based Stroop task is given in Appendix D.5.

9.4.3 Procedure.

Task and questionnaires were counterbalanced between each participant. However, the DSHI was always be administered at the end of the data collection

session, in order to minimise discussion of sensitive topics, and to allow participants time to discuss any issues or concerns they may have.

9.5 Results

9.5.1 Self-harm and affect.

There were 26 (56.52%) participants that reported previous self-harm, and Table 9.2 displays the differing types of self-harm and the percentage of participants that endorsed each behaviour. As in study 1, cutting the skin was the most commonly used method of self-harm reported by participants which is generally consistent with the literature (e.g., Klonsky, 2007). Examples of the miscellaneous self-harm behaviours reported ranged from overdosing on medication, self-strangling, starving oneself or purging, hair pulling, using objects (e.g., trapping fingers in doors), and in one case self-poisoning by drinking bleach.

Table 9.2 Types of Self-harm Reported

Type of self-harm behaviour	Number of Ps who have used this method (n = 26)
Cutting	24 (92.3%)
Scratching	18 (69.2%)
Sticking needles/sharp objects into skin	15 (57.7%)
Miscellaneous	13 (50%)
Interfering with wounds	13 (50%)
Biting	10 (38.5%)
Punching self	9 (34.6%)
Carving words	8 (30.8%)
Carving pictures/designs	6 (23.1%)
Head banging	5 (15.4%)
Burning	4 (15.4%)
Cigarette burn	4 (15.4%)
Rubbing sandpaper on the skin	3 (11.5%)
Applied acid to the skin	3 (11.5%)
Bleach/chemical burns	2 (7.7%)
Rubbed glass into the skin	2 (7.7%)
Broken bones	1 (3.8%)

Both positive and negative affect ratings met parametric assumptions, therefore comparison of means was via independent samples t-test, and significance reported is one-tailed because self-harm is usually considered to function as a way

of regulating high negative affect. Levene's test for equality of variances was significant for both affect variables, consequently equal variances were not assumed. The self-harm group demonstrated significantly lower Positive affect and significantly higher Negative affect compared to controls, which is consistent with the affect regulation model of self-harm (Brown et al., 2002; Gratz & Roemer, 2008; Gratz et al., 2009; Klonsky, 2007; Nock, 2007; Nock & Prinstein, 2004; Suyemoto, 1998). Both effect sizes (Cohen's *d*) can be considered very large using Cohen's (1988) criteria of effect size (.2 = small effect, .5 = moderate effect, .8 = large effect) as can be seen in Table 9.3.

Table 9.3 Measures of Positive and Negative Affect

		Control group	Self-harm group	
	Cronbach's α (no of items)	Min - max Mean (*SD*)		Sig
Positive affect (PANAS)	.91 (10)	20 - 43 33.00 (6.32)	13 - 38 26.00 (8.28)	$t(44) = 3.39$, $p = .001$, $d = .95$
Negative Affect (PANAS)	.91 (10)	11 - 29 18.10 (6.06)	13 - 43 28.54 (9.82)	$t(42.26) = -4.43$, $p < .001$, $d = 1.28$

9.5.2 BPD features.

Scores for the all the BPD measures met parametric assumptions, therefore comparison of means was via independent samples t-test, and significance reported is one-tailed as it was hypothesised those individuals who reported previous self-harm would exhibit higher levels of BPD feature compared to controls. Levene's test for equality of variances was significant for the SCID, and the Negative Relationships subscale of the PAI, and so for those measures, equal variances were not assumed.

The data supported this hypothesis as the participants who reported previous self-harm scored significantly higher than controls on every BPD measure as hypothesised, as seen in Table 9.4. All effect sizes (Cohen's *d*) can be considered large - very large using Cohen's (1988) criteria of effect size.

Table 9.4 Measures of BPD Features

		Control group	Self-harm group	
	Cronbach's α (no of items)	Min - max Mean (*SD*)		Sig
SCID-BPD	.91 (15)	17 - 43 26.90 (6.28)	20 - 59 38.04 (10.12)	$t(42.34) = -4.58$, $p < .001$, $d = 1.35$
PAI-BOR Affective Instability subscale	.39 (6)	3 - 14 7.65 (3.57)	3 - 18 11.34 (4.67)	$t(44) = -2.93$, $p = .003$, $d = .89$
PAI-BOR Identity Problems subscale	.61 (6)	0 - 15 7.55 (4.11)	5 - 17 12.00 (3.46)	$t(44) = -3.98$, $p < .001$, $d = 1.17$
PAI-BOR Negative Relationships subscale	.50 (6)	3 - 13 7.55 (2.58)	3 - 17 10.65 (3.82)	$t(43.40) = -3.28$, $p = .001$, $d = .95$
PAI-BOR Self-harm Subscale	.59 (6)	3 - 12 5.60 (2.70)	3 - 15 8.23 (3.42)	$t(44) = -2.83$, $p = .004$, $d = .85$
PAI-BOR total	.83 (24)	17 - 49 28.35 (10.11)	20 - 63 42.23 (12.16)	$t(44) = -4.12$, $p < .001$, $d = 1.24$
PAI-BOR TScore*	-	49 - 81 60.35 (10.11)	52 - 95 74.23 (12.16)	$t(44) = -4.12$, $p < .001$, $d = 1.24$

*T-Scores < 60T are fairly healthy, 60 – 69T represent a moderate elevation, scores >70T and above are indicative of problematic symptoms, scores greater >90T are generally seen only in clinical samples and indicate markedly elevated symptoms, possibly an individual in crisis.

9.5.3 Executive functions.

Before analysing the executive function data, IQ scores were examined. Levene's test for equality of variances was not significant for the IQ measures; consequently equal variances were assumed. There were no significant differences in IQ scores for either the verbal or performance subscales, or the full four-scale IQ between participants who reported self-harm and controls as can be seen in Table 9.5.

Table 9.5 WASI IQ Test Scores

	Control group	Self-harm group	
		Min - max Mean (*SD*)	Sig
WASI IQ verbal	86 - 139 104.80 (12.53)	88 - 120 102.62 (9.05)	$t(44) = .69$, $p = .469$
WASI IQ performance	77 - 129 104.95 (10.71)	78 - 120 105.04 (10.15)	$t(44) = -.03$, $p = .977$
WASI IQ full four-scale IQ	84 - 130 105.75 (11.85)	86 - 118 104.35 (7.47)	$t(44) = .49$, $p = .626$

For the self-report measure of attentional control (the ACS), the same three-factor scale was used as in study 1, described by Fajkowska and Derryberry (2010). Comparison of means was via independent samples t-test for the three subscales since they met parametric requirements, however the ACS overall score violated parametric assumptions because the data was skewed, consequently the Mann-Whitney was used for the overall score. Significance reported is two-tailed, because in study 1 attentional control was a risk factor for self-harm for some participants, but appeared to be a protective factor for others. In the case of Mann-Whitney, exact significance is reported. Levene's test for equality of variances was significant only for the flexibility subscale; consequently equal variances were not assumed for this variable. There were no significant difference on the ACS subscales, but the self-harm group had significantly lower overall scores on the ACS compared to controls (see Table 9.6). However, the approximated effect size ($r = z / \sqrt{N}$), $r = -.29$, is considered relatively small using Cohen's (1988) criteria of effect size.

Table 9.6 Attentional Control Scale

		Control group	Self-harm group	
	Cronbach's α (no of items)	Min - max Mean (*SD*)		Sig
ACS Focusing	.71 (9)	11 - 28 20.35 (4.51)	11 - 31 18.23 (4.41)	$t(44) = 1.60$, $p = .117$
ACS Shifting	.61 (6)	13 - 21 16.70 (2.81)	9 - 21 15.12 (3.08)	$t(44) = 1.80$, $p = .079$
ACS flexibility	.50 (5)	6 - 17 11.55 (3.27)	7 - 14 10.19 (1.90)	$t(28.67) = 1.66$, $p = .109$
		Min – max Median (interquartile range)		
ACS overall	.76 (20)	36 - 64 46.00 (10.75)	31 - 66 43.50 (9.25)	$U = 170.50$, $z = -1.99$, $p = .047$, $r = -.29$

Scores for all the measures on the Hayling tasks were skewed and violated parametric assumptions, therefore comparison of means was via a Mann-Whitney U test, and significance reported is exact and one-tailed as it was hypothesised that individuals who report previous self-harm would exhibit executive function deficits compared to controls (see Table 9.7). Compared to controls, the self-harm group had significantly poorer global performance on the Hayling task overall, and demonstrated longer reaction times on both section 1 (sensible completion) and section 2 (unconnected completion) which could suggest deficits in response initiation and suppression. The approximated effect sizes were moderate. In addition, median scores were generally average in both groups, but as the control group demonstrated superior performance overall (with a median score of 7, which is 'high average'), it could be argued that the differences observed are a result of superior performance in the control group rather than deficits in the self-harm group.

There were no significant differences in the number of errors on section 2 of the task, which suggests that the self-harm group can effectively suppress an incorrect response as well as the control group. This indicates that the self-harm

group are not impulsive, but likely have difficulty with the task for other reasons such as being unable to disengage from the correct response quickly.

Table 9.7 Hayling Sentence Completion Task

	Control group	Self-harm group	
	Min - max Median (interquartile range)		Sig
Hayling Section 1 – Sensible completion	3 - 7 6.00 (1.00)	5 - 7 6.00 (1.00)	$U = 150.00$, $z = 2.76$, p = .003, $r = .41$
Hayling Section 2 – Unconnected completion	6 - 8 6.00 (.75)	4 - 7 6.00 (.00)	$U = 182.00$, $z = -2.50$, p = .011, $r = .37$
Hayling Section 2 – Error score	2 - 8 7.00 (2.00)	1 - 8 6.50 (1.25)	$U = 209.00$, z = -1.17, $p = .124$
Hayling overall score	4 - 10 7.00 (1.00)	3 - 7 6.00 (1.00)	$U = 139.00$, $z = -2.87$, $p = .001$, $r = .42$

Note: Scores: 7 = High average, 6 = Average, 5 = Moderate average, 4 = Low average, 3 = Poor, 2 = Abnormal, 1 = Impaired.

The following tables show descriptive statistics and tests of significance for the D-KEFS and are ordered by task. Scoring on the D-KEFS takes the form of converting raw scores to scaled scores that have a mean of 10, and a standard deviation of 3. Scaled scores are corrected for age groups as well as the cumulative percentile ranks for some measures. Higher scaled scores on a task typically represent better performance and fewer errors, the exception being contrast scores. Both low and high contrast scores may reflect specific different types of cognitive deficits, depending on the task.

9.5.3.1 Verbal fluency.

Letter fluency total correct, Switching total correct, Switching accuracy, and Category switching Vs. Category fluency measures met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is one-tailed as it was hypothesised that individuals who report previous

self-harm would exhibit verbal fluency deficits compared to controls. These are shown in the upper section of Table 9.8. Levene's test for equality of variances was significant for the Category switching Vs. Category fluency measure so for that variable equal variances were not assumed. Category fluency part 2 total correct, Letter fluency Vs. Category fluency, Set-loss errors, Repetition errors and Percentage switching accuracy violated parametric assumptions because the data was skewed, consequently the Mann-Whitney was used. Significance reported is exact and one-tailed and is presented in the lower section of Table 9.8. There were no significant differences in performance on any of the D-KEFS verbal fluency task measures, which suggests that there are no deficits in fluency of generating lexical items whilst simultaneously observing rules or restrictions.

Table 9.8 D-KEFS Verbal Fluency Task

	Control group	Self-harm group	
		Min - max Mean (*SD*)	Sig
Letter fluency total correct	6 - 19 10.95 (3.24)	6 - 17 10.35 (2.71)	$t(44) = .69$, $p = .50$
Switching total correct	2 - 17 11.10 (3.71)	5 - 18 11.15 (3.19)	$t(44) = -.02$, $p = .99$
Switching accuracy	6 - 18 11.85 (2.91)	8 - 19 12.31 (2.62)	$t(44) = -.56$, $p = .578$
Category switching Vs. Category fluency	6 - 18 10.60 (2.68)	3 - 19 9.69 (3.94)	$t(43.46) = -.93$, $p = .358$
		Median (interquartile range)	
Category fluency 2 total correct	4 - 15 10.80 (3.16)	7 - 19 11.23 (2.72)	$U = 255.00$, $z = -.11$, $p = .46$
Letter fluency Vs. Category fluency	1 - 15 11.50 (3.50)	3 - 18 9.00 (5.25)	$U = 196.00$, $z = -1.43$, $p = .08$
Set-loss errors	10 - 13 13.00 (.00)	10 -13 13.00 (.00)	$U = 241.00$, $z = -.78$, $p = .29$
Repetition errors	8 - 13 12.00 (2.00)	4 - 13 12.00 (2.50)	$U = 227.00$, $z = -.77$, $p = .23$
Percentage switching accuracy	9 - 13 12.00 (.00)	3 - 13 12.00 (.00)	$U = 245.00$, $z = -.47$, $p = .35$

9.5.3.2 Design fluency.

Total correct, Switching Vs. total correct, condition 1 (filled dots) + condition 2 (empty dots), and Total attempted designs met parametric assumptions, consequently comparison of means was via independent samples t-test. Significance reported is one-tailed as it was hypothesised that individuals who report previous self-harm would exhibit design fluency deficit compared to controls. These are shown in the upper section of Table 9.9. Levene's test for equality of variances was significant for the Category switching Vs. Category fluency measure so for that variable equal variances were not assumed. Set loss errors, Repeated designs, and Percentage design accuracy violated parametric assumptions as the data was skewed, consequently the Mann-Whitney was used, and significance reported is exact and one-tailed and is presented in the lower section of Table 9.9.

Individuals in the self-harm group had poorer performance on total number of correct designs and the condition 1 (filled dots) + condition 2 (empty dots) condition. However, because their performance appeared to be average, this difference appears to be due to superior performance by the control group rather than deficits in the self-harm group. The self-harm group were also significantly impaired on the contrast variable of design fluency switching vs. combined scaled score compared to controls and the effect size (Cohen's d) is large. Because performance was relatively average on conditions 1 and 2, but impaired in the switching condition, this suggests primarily a degree of impairment in switching ability over and above any design fluency deficits.

Table 9.9 D-KEFS Design Fluency Task

	Control group	Self-harm group	
		Min - max Mean (*SD*)	Sig
Total correct	9 - 16 12.30 (2.27)	6 - 19 11.19 (3.03)	$t(44) = 1.36$, $p = .009$, $d = .41$
Switching Vs. total correct	5 - 19 11.45 (2.91)	1 - 14 8.77 (4.30)	$t(43.39) = 2.52$, $p = .008$, $d = .73$
condition 1 (filled dots) + condition 2 (empty dots)	9 - 16 12.10 (1.94)	7 - 18 10.54 (2.66)	$t(44) = 2.21$, $p = .016$, $d = .67$
Total attempted designs	8 - 19 12.45 (3.14)	6 - 19 11.31 (3.15)	$t(44) = 1.22$, $p = .114$
		Min – max Median (interquartile range)	
Set loss errors	1 - 14 13.00 (3.50)	6 - 14 13.00 (1.25)	$U = 237.00$, $z = -.53$, $p = .301$
Repeated designs	7 - 14 12.00 (1.00)	3 - 13 12.00 (2.00)	$U = 215.00$, $z = -1.04$, $p = .153$
Percentage design accuracy	1 - 13 10.50 (3.25)	1 - 14 10.00 (4.25)	$U = 207.00$, $z = 1.18$, $p = .122$

9.5.3.3 Sorting Task.

Condition 1 correct sorts, Condition 1 description, Condition 1 attempted sorts, Combined 1 & 2 verbal score, and Combined 'don't know' responses met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is one-tailed as it was hypothesised those individuals who report previous self-harm would exhibit impaired task performance compared to controls. Levene's test for equality of variances was non-significant for the all the measures so equal variances were assumed and these are shown in the upper section of Table 9.10. For scores that violated parametric assumptions because the data was skewed (Condition 2 description, Condition 1 & 2 combined description score, Sort recognition Vs. free sort, Condition 1 set loss sorts, Condition 1 sorting accuracy, Condition 1 time per sort ratio, Condition 1 percentage description accuracy, Combined 1 & 2 perceptual score, Combined overly abstract answers (percentile rank), Combined incorrect descriptions, Combined repeated

descriptions), the Mann-Whitney was used. Significance reported is exact and one-tailed, and is presented in the lower section of Table 9.10.

Table 9.10 D-KEFS Sorting Task

	Control group	Self-harm group	
		Min - max Mean (*SD*)	Sig
Condition 1 correct sorts	3 - 16 11.05 (2.89)	7 - 13 9.88 (1.61)	$t(44) = 1.74$, $p = .0445$, $d = .50$
Condition 1 description	3 - 15 10.60 (2.76)	6 - 13 9.69 (2.05)	$t(44) = 1.28$, $p = .11$
Condition 1 attempted sorts	6 - 17 11.05 (2.80)	6 - 15 9.48 (2.80)	$t(44) = 1.51$, $p = .006$, $d = .56$
Combined 1 & 2 verbal score	5 - 13 9.60 (2.58)	1 - 11 6.92 (2.92)	$t(44) = 3.24$, $p = .001$, $d = .97$
Combined 'don't know' responses	10 - 15 12.60 (1.35)	8 - 15 12.12 (1.53)	$t(44) = 1.12$, $p = .135$
		Min – max Median (interquartile range)	
Condition 2 description	3 - 15 12.00 (1.75)	1 - 13 9.00 (4.00)	$U = 135.00$, $z = -2.79$, $p = .002$, $r = .41$
Condition 1 & 2 combined description score	2 - 14 11.00 (2.75)	3 - 13 9.00 (3.00)	$U = 171.00$, $z = -2.00$, $p = .023$, $r = .29$
Sort recognition Vs. free sort	4 - 13 10.00 (4.25)	3 - 16 10.00 (4.25)	$U = 224.50$, $z = -.80$, $p = .216$
Condition 1 set loss sorts	0	0 – 2 00 (.00)	$U = 240.00$, $z = -1.25$, $p = .314$
Condition 1 sorting accuracy	4 - 13 10.50 (3.00)	7 - 13 11.00 (2.25)	$U = 242.50$, $z = -.40$, $p = .351$
Condition 1 time per sort ratio	3 - 27 10.00 (2.75)	6 - 13 11.00 (2.00)	$U = 209.50$, $z = -1.14$, p = .129
Condition 1 percentage description accuracy	3 - 14 11.00 (3.50)	5 - 14 10.00 (4.00)	$U = 220.50$, $z = -.88$, $p = .192$
Combined 1 & 2 perceptual score	1 - 16 13.00 (3.00)	3 - 15 9.00 (3.75)	$U = 116.00$, $z = -3.21$, $p = .000$, $r = .47$
Combined overly abstract answers (percentile rank)	1 - 100 100.00 (00)	3 - 100 100.00 (83.25)	$U = 220.50$, $z = -1.17$, $p = .136$
Combined incorrect descriptions	6 - 14 12.50 (2.75)	7 - 13 13.00 (3.00)	$U = 258.00$, $z = -.05$, $p = .483$
Combined repeated descriptions	2 - 100 100.00 (00)	6 - 100 100.00 (19.50)	$U = 216.00$, $z = -1.56$, p = .098

Compared to healthy controls, individuals who reported previous self-harm performed significantly worse in Condition 1 (total number of correct sorts) since they

made fewer attempted sorts and had fewer accurate responses (independent of description) than the control group with a medium effect size. A lower number of attempted and accurate sorts suggest some impairment in initiation of problem-solving behaviour. The self-harm group also demonstrated poorer performance on the combined overall descriptions, which is due to significantly poorer performance on condition 2 (sort recognition condition) as their performance on condition 1 (free sort) was normal. These results are likely not due to inhibition deficits or perseverative tendencies, as contrast scores and number of repetition errors are within the normal range. They are also likely not due to language or spatial deficits since there were no significant differences in measures no of verbal and performance IQ.

Instead, these results suggest that these deficits are likely be due to deficient conceptual reasoning and problem solving in both the perceptual and verbal domain, since the self-harm group exhibited a deficit across both modalities compared to the controls. They had particularly poor performance in the verbal-semantic domain since the effect size was very large compared to the visual-perceptual domain (which had a medium effect size). Although it is currently unclear how differences in modality specific processing should be interpreted (Delis et al., 2001), taken together the results from the sorting task suggests that individuals who self-harm appear to exhibit conceptual reasoning and initiation of problem solving behaviour across multiple modalities.

9.5.3.4 Attachment-based Stroop task.

Following the generally accepted format of data analysis for emotional Stroop task data (e.g., Ratcliff, 1993; McKenna & Sharma, 1995); Thomas, Johnstone, & Gonsalvez, 2007; Wiffen et al., 2014), mean accuracy (correct responses) and

reaction times (in milliseconds) for responses to each word type (positive, negative, and neutral) were calculated for each participant. In order to ensure normality of data and to minimise the effects of large variations in RT, outlying responses (defined as outside 2 standard deviations of the overall word type mean RT) (Ratcliff, 1993) were not analysed (1 participant on all three word types), leaving 45 participants in the sample for further analysis. Table 9.11 shows the mean and standard deviation of the Stroop RT times and accuracy (correct responses).

Table 9.11 Results for the Attachment Based Stroop Task.

	Positive words		Negative words		Neutral words	
	Mean RT (*SD*)	Mean overall accuracy (*SD*)	Mean RT (*SD*)	Mean overall accuracy (*SD*)	Mean RT (*SD*)	Mean overall accuracy (*SD*)
Control group	563.54 (99.64)	53 - 63 61 (2.79)	573.74 (92.34)	47 - 63 60.85 (3.57)	546.89 (98.72)	52 - 63 61.60 (2.50)
SH group	574.08 (64.62)	58 - 63 61.81 (1.44)	566.01 (98.72)	57 - 63 61.92 (1.47)	574.28 (64.38)	55 - 63 61.31 (1.89)

The mean RT scores were analysed using a mixed between-within subjects Analysis of Variance (ANOVA), with self-harm status (yes or no) as the between subjects variable and word-type (positive, neutral, or negative) as the within-groups variable. Sphericity was violated and so a Greenhouse-Geisser correction was applied, and Levene's test of equality of error variances was not significant so equal variances were assumed. There was no significant interaction for RTs between self-harm status and word type, Wilks' Lambda = .93, $F(2, 42) = 1.49$, $p = .24$, partial $Eta^2 = .07$. There was no significant main effect of word type, Wilks' Lambda = .95, $F(2, 41) = 1.03$, $p = .37$, partial $Eta^2 = .05$ with both groups failing to demonstrate the classic emotional Stroop effect. The main effect of self-harm was also not significant, $F(1, 43) = .20$, p=.66, partial $Eta^2 = .01$, suggesting no significant differences in performance between those who self-harm and those who do not.

The accuracy scores were then analysed using a mixed ANOVA as described in the previous paragraph. Mauchly's test of sphericity was not significant and so sphericity was assumed, and Levene's test of equality of error variances was significant for positive words (p = .04), therefore a more conservative alpha rate of p =. 025 was set for that variable as suggested by Tabachnick and Fidell (2013). There was a significant interaction in accuracy between self-harm status and word type, Wilks' Lambda=.78, $F(2, 42) = 5.96$, p =. 002, partial Eta^2 = .22 which has a medium – large effect size (Cohen, 1988). To break down this interaction, contrasts were performed comparing accuracy for positive and negative words to the neutral words across self-harm vs no self-harm groups. These revealed significant interactions when comparing self-harm to none self-harm accuracy for neutral words compared to positive words, $F(1, 43) = 5.71$, p = .021, partial Eta^2 = .12 which is approaching a medium effect size. The plot in Figure 9.1 suggests that individuals who report previous self-harm were slightly more accurate compared to controls for identifying the colour of positive words. There was no significant main effect word type, Wilks' Lambda = 1, $F(2, 42) = .04$, p = .96, partial Eta^2 = .00 or self-harm status, $F(1, 43) = .56$, p = .46, partial Eta^2 = .01.

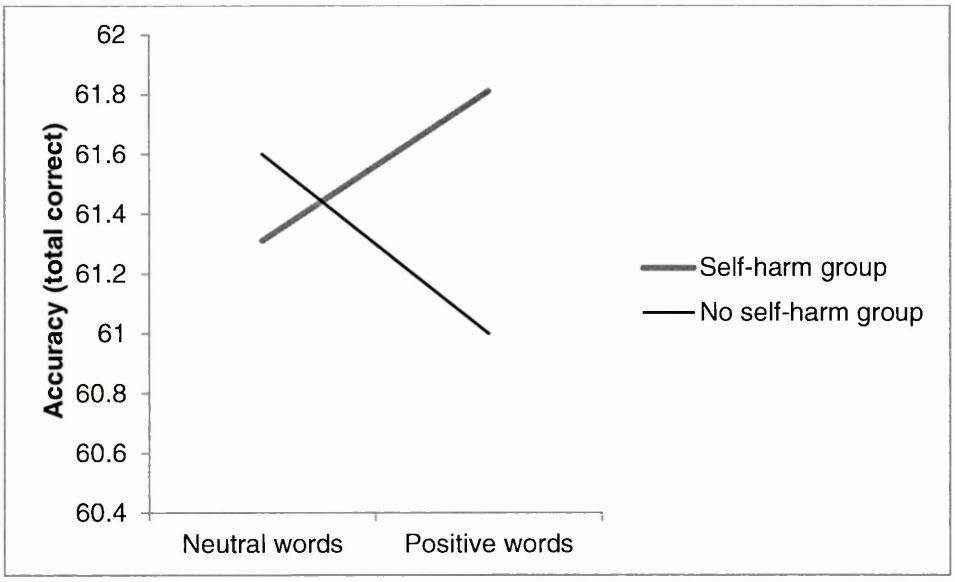

Figure 9.1 Interaction of self-harm group and accuracy ratings for neutral and positive words.

9.5.4 Attachment orientation and vignette task.

9.5.4.1 Attachment orientation.

Scores for both attachment avoidance and attachment anxiety met parametric assumptions, therefore comparison of means was via independent samples t-test, and significance reported is one-tailed as it was hypothesised those individuals who report previous self-harm would exhibit higher levels of attachment insecurity compared to controls. Levene's test for equality of variances was not significant for both subscales and so equal variances were assumed. The data supported this hypothesis as the participants who reported previous self-harm reported significantly higher attachment anxiety and avoidance than controls, as seen in Table 9.12. The effect sizes (Cohen's d) can be considered large - very large (Cohen, 1988).

Table 9.12 Attachment Insecurity Descriptive Statistics

		Control group	Self-harm group	
	Cronbach's α (no of items)	Min - max Mean (*SD*)		Sig
ECR Attachment avoidance	.96 (18)	19 - 79 39.50 (17.82)	21 - 104 66.65 (24.03)	$t(44) = -4.23$, $p < .001$, $d = 1.28$
ECR Attachment anxiety	.94 (18)	28 - 111 64.25 (21.76)	41 - 121 84.58 (20.02)	$t(44) = -3.29$, $p = .001$, $d = .97$

Individuals can be assigned to Bartholomew and Horowitz's (1991) attachment styles for descriptive purposes using the algorithm freely available from the official ECR website (http://www.psych.uiuc.edu/~rcfraley/measures/brennan.html#scoring). The median scores overall for attachment avoidance was 57.00, and 75.74 for attachment anxiety. Using these as the basis to categorise participants, in the control group 6 participants (13%) were secure, 5 (10.9%) were fearful, 4 (8.7%) were dismissing and 5 (10.9%) were preoccupied. In the self-harm group, 1 participant (2.2%) was secure, 20 (43.5%) were fearful, 3 (6.5%) were dismissing and 2 (4.3%) were preoccupied. This is illustrated in Figure 9.2, strikingly the fearful attachment style was more frequently reported by individuals who have previously self-harmed compared to control. The trend was reversed for secure attachment, and there was little difference in the dismissing style.

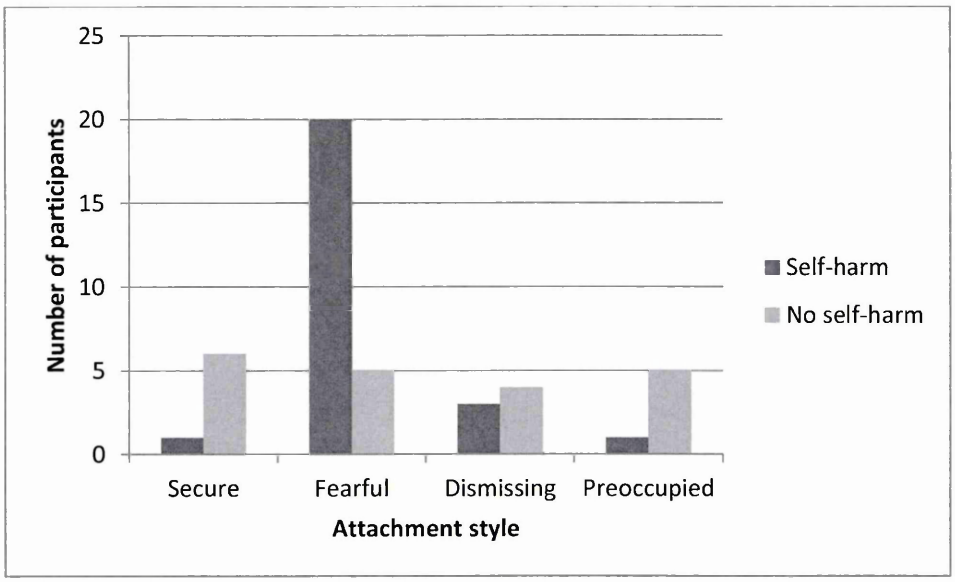

Figure 9.2 Attachment styles compared by group

9.5.4.2 Vignette task.

All 6 self-esteem items were collapsed to produce an overall self-esteem response, as were all 6 other-esteem items to form an overall other-esteem response. Lower scores indicate lower levels of reported self and other-esteem. All 6 likelihood of self-harm items were collapsed to form an overall likelihood of self-harm variable, with higher scores indicating a higher intent to self-harm. Only the other-esteem ratings met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is one-tailed as it was hypothesised those individuals who report previous self-harm would exhibit lower levels of self and other-esteem and a higher intent to self-harm compared to controls. These are shown in the upper section of Table 9.13. Levene's test for equality of variances was not significant so equal variances were assumed. Self-esteem and likelihood of self-harm ratings violated parametric assumptions as the data was skewed, consequently the Mann-Whitney was used. Significance reported is exact and one-tailed and is presented in the lower section of Table 9.13. There

were significant differences in both the self and other esteem ratings, as individuals who previously self-harmed reported lower esteem ratings than controls, there was a large effect size for self-esteem and a medium effect for other esteem using Cohen's (1988) criteria. Individuals who had previously self-harmed also reported a higher likelihood of self-harm after exposure to the vignettes compared to controls with a large - very large effect size.

Table 9.13 Overall Ratings for the Vignette Task

	Cronbach's α	Control group	Self-harm group	Sig
		Min-max Mean (*SD*)		
Other-esteem	.81 (6 items)	8 - 20 13.55 (3.61)	6 - 17 11.31 (2.62)	$t(44) = 2.45$, $p = .001$, $d = .71$
		Min – max Median (IQR)		
Overall self-esteem	.50 (6 items)	9 - 29 14.50 (6.75)	6 - 20 10.00 (4.00)	$U = 99.00$, $z = -3.58$, $p < .001$, $r = -0.53$
Likelihood of self-harm	.96 (6 items)	6 - 14 6.00 (.75)	6 - 35 23.00 (17.00)	$U = 38.50$, $z = -5.04$, $p < .001$, $r = -0.74$

9.5.5 Interim summary of results.

Preliminary analysis of the data supported the hypothesis that individuals who reported previous self-harm would also report significantly higher levels of BPD features compared to controls. They also had significantly higher negative affect and lower positive affect, which is consistent with the findings from Study 1. The findings from Study 1 were not replicated with regards on the attentional control scale, since the self-harm group only had significantly lower attentional control rating for the overall scale but not the individual subscales of focusing, shifting, and flexibility.

There was partial support for the hypothesis that individuals who report previous self-harm would exhibit executive function deficits. On the executive

function tasks, the self-harm group had significantly poorer global performance on the Hayling task overall, and demonstrated longer reaction times on both section 1 and section 2 of the task. There were no significant differences for number of errors, which suggests that the self-harm group can effectively suppress an incorrect response as well as the control group and are not impulsive. Therefore, a more likely explanation is that they have difficulty with the task because they may be unable to disengage from the appropriate response.

On the D-KEFS battery, there were no differences for performance of the verbal fluency task. On the design fluency task, the self-harm group had impaired performance on the switching component of the task compared to controls. On the sorting task, the self-harm group exhibited difficulties in initiating problem solving behaviour, and concept formation in both verbal and non-verbal domains. There were no differences in RTs on the Stroop task, but the self-harm group were more accurate at identifying the colour of positive words compared to neutral words in comparison with the control group. However, these results should be treated cautiously given that there were no other differences in RTs or accuracy.

There was also support for the hypothesis that there would be higher levels of attachment insecurity (avoidance and anxiety) in the self-harm group compared to controls, they were much more likely to report a fearful or preoccupied attachment style and less likely to report a secure attachment style. There was also evidence to support the hypothesis that the self-harm group would demonstrate social cognitive processing biases as measured by reduced self and other-esteem, and an increased likelihood of self-harm harm after exposure to the vignettes compared to controls.

9.5.6 Mediation and moderation analysis.

To test the hypotheses that EFs and/or attachment organisation will mediate and/or moderate the relationship between BPD features and intent to self-harm after exposure to the vignettes, it was necessary to reduce the data. Items relating to self-harm behaviours were removed from BPD scales to avoid collinearity with the outcome measure. Both the SCID (.89, 13 items) and PAI with self-harm items removed had acceptable alpha levels (.89, 18 items). Given that the two BPD scales were measuring the same underlying construct, and the correlation between the measures was moderate to large in magnitude ($r = .84$, $p < .001$), a composite variable representing BPD features was created, in order to provide more reliable measures (e.g., Cheavens et al., 2005; Sprague & Verona, 2010). Individual scores were standardised (Z-transformed) and then summed in order to create an overall index of BPD features. This standardised BPD scale with the self-harm related items removed demonstrated good internal consistency ($\alpha = .94$, 31 items). The combined BPD scale met parametric assumptions, therefore comparison of means was via independent samples t-test, and significance reported is one-tailed as it was hypothesised those individuals who reported previous self-harm would exhibit higher levels of BPD feature compared to controls. Levene's test for equality of variances was not significant and so equal variances were assumed. As would be expected from the previous result, the self-harm group reported significantly higher BPD features than the control group, with a very large effect size (Cohen's *d*) (see Table 9.14).

Table 9.14 Combined BPD Measure Descriptive Statistics

	Controls	Self-harm group	Sig
	Min – max Mean (*SD*)		
Combined BPD scale	-3.10 - 2.3 -1.11(1.40)	-2.2 - 4.20 .85 (1.84)	$t(44) = -3.95$, $p < .001$, $d = 1.4$

9.5.6.1 Do EFs mediate or moderate the relationship between BPD features and previous self-harm?

A hierarchical logistic regression model was used to examine the possible contribution of BPD features, and executive function measures to the probability of reporting previous episodes of self-harm. Self-harm was, therefore, the criterion variable, and it was decided that a binary variable simply indicating whether individuals had ever engaged in self-harm was most appropriate. The variable was coded 1 to indicate prior self-harm and 0 to indicate no prior self-harm. In order to reduce the number of variables entered in to the regression due to the relatively low sample size, the Hayling Overall score was selected for analysis since it is a measure of global executive functioning. The primary measures of total correct and switching from the D-KEFS design fluency and the primary measures of Condition 1 and 2 combined description score from the sorting task was also included since there was a significant difference between group performance. The BPD variable was entered in the first step and the EF tasks in the final step of the regression to examine whether deficits in specific components of EF would partially explain the association between BPD and previous self-harm.

The full model containing all predictors was significant at the final step (χ^2 (5) = 23.18, p = < .001) compared to the constant only model, indicating that the full model distinguished between participants who reported previous instances of self-harm and those who did not (see Table 9.15). The model as a whole explained

between 39.60% (Cox & Snell R^2) to 53.1% (Nagelkerke R^2) of the variation in self-harm and correctly classified 80.40% of cases. There were five independent variables at the final step, the only one of which to make a unique and significant contribution to the probability of reporting self-harm was level of BPD features. This suggests that the EF measures included in the regression do not mediate or moderate the relationship between level of BPD features and previous self-harm.

Table 9.15 Hierarchical Logistic Regression of BPD and EF Tasks Predicting Previous Self-harm.

	R^2	Odds Ratio	95% CI
	R^2_a - R^2_b		*Lower, Upper*
Step 1	.26 - .35		
BPD		2.04, p = .002	1.29, 3.21
Step 2	.40 - .53		
BPD		1.95, p = .007	1.20, 3.17
Hayling overall		.66, p =.36	.27, 1.60
D-KEFS design fluency total correct		.88, p = .45	.63, 1.23
D-KEFS design fluency switching contrast		.83, p = .13	.65, 1.06
Sorting task combined description		.80, p = .25	.55, 1.17

To confirm that EFs do not mediate or moderate the relationship between BPD features and self-harm, a composite variable of the eight EF tests that were significantly different between groups was created (The three Hayling measures, and the D-KEFS Design fluency primary contrast, Sorting Task Condition 2 primary description, Sorting Task Combined Description, Sorting Task verbal measure and perceptual measure) (α = .78, 8 items). This is a relatively common procedure (e.g., Braun, Guimond, Payette & Daigneault, 2013; Glass et al., 2009) performed by standardizing (Zscores) and combining scores from individual EF tasks, as relationships are often larger when using global; or composite measures of neurocognition (Green, Kern, Braff & Mintz, 2000). In addition it was necessary to reduce the number of variables entered in to the regression due to the low sample

size (estimates suggest at least 15 participants per predictor). A simple mediation analysis using ordinary least square regression analysis was conducted between BPD and previous self-harm, with the combined EF as the mediator. All mediation and moderation analysis described in this section was carried out by the PROCESS macro for SPSS described by Hayes (2013), with bias-corrected bootstrap confidence intervals based on 5000 bootstrap samples. All coefficients are reported in their unstandardised forms.

A conceptual diagram of the model can be seen in Figure 9.3, and the results show that those with higher levels of BPD features are more likely to have a lower overall combined EF index score but not significantly (a = -.62, p = .11), and EF was associated with a reduced likelihood of previous self-harm (b = -.31, p = .004). A bias corrected bootstrap confidence interval for the indirect effects (ab = .19) contained zero (-.01, .73), and the normal theory test (Sobel) was not significant (p = .17). Therefore it can be concluded that there is no mediating effect of the combined EF variable. A moderation analysis was also conducted, to examine how the interaction between BPD and EF may predict previous self-harm. The results can be seen in Table 9.16 and suggest that there is no moderating effect of the combined EF variable.

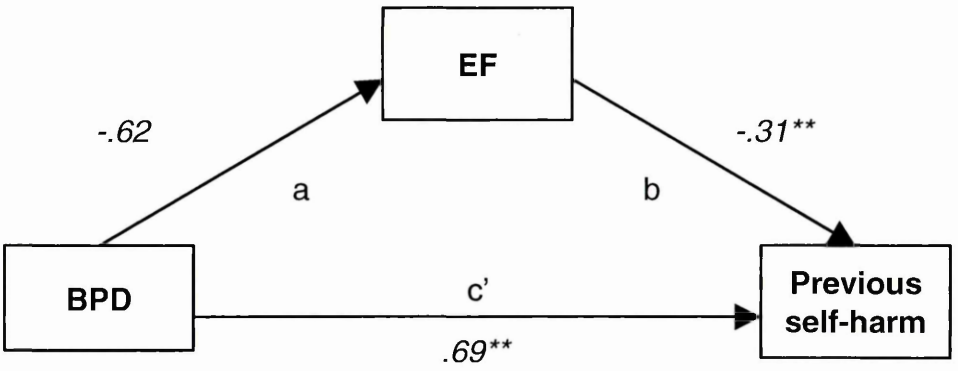

Figure 9.3 Conceptual diagram of the mediated relationship between BPD and self-harm with EF as the mediator. *$p < .05$, **$p < .001$

Table 9.16 Moderation Analyses of BPD and Self-esteem.

Predictor	Coefficient (*SE*)	CI 95% Lower, Upper
EF	-.30 (.12), $p = .31$	-.41, 1.28
BPD	.69 (.26), $p = .01$	.18, 1.21
EF x BPD interaction	.01 (.08), $p = .85$	-.13, .16

9.5.6.2 Does attachment insecurity mediate or moderate the relationship between BPD and likelihood of future self-harm?

A hierarchical linear regression model was used to examine the possible contribution of BPD features, attachment insecurity, and self-esteem to the intent to self-harm after exposure to the vignettes, therefore intent to self-harm was the criterion variable. In order to reduce the number of variables entered in to the regression due to the relatively low sample size, the other-esteem variable was not included in any further analysis due to its low alpha, which indicated poor internal validity. Nor was the measure of negative affect included as the combined BPD scale contains a large number of items purported to measure various aspects of

BPD related to negative affectivity. The BPD variable was entered in the first step and attachment anxiety and avoidance in the second step, and self-esteem in the final step, using the enter method. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity.

At the final step, it was found that BPD features, attachment insecurity (as attachment avoidance and anxiety, along with self-esteem explained a significant amount of variance in the intent to self-harm ($F(4,41) = 21.14$, $p < .001$, $R^2 = .67$, R^2 adjusted = .64). BPD features ($B = .42$, $t = 2.58$, $p = .014$) and self-esteem ($B = -.28$, $t = -2.53$, $p = .015$) were the only unique significant predictors in the final step, which suggests rather than attachment insecurity per se mediating or moderating the relationship between BPD features and intent to self-harm, it may be via reduction in self-esteem (see Table 9.17).

Table 9.17 Linear Regression of BPD, Intent to Self-harm, Attachment Insecurity and Self-esteem.

	R	Beta (*SE*)	Standardised Beta	95% CI Lower, Upper	Adjusted R^2	*F*-change
Step 1:	.77				.58	64.00, $p < .001$
BPD features		4.02 (.51)	.77, $p < .001$	3.01, 5.03		
Step 2:	.79				.60	1.66, $p = .203$
BPD features		2.72 (.87)	.52, $p = .003$	.98, 4.47		
Attachment Avoidance		.05 (.05)	.12, $p = .31$	.14, .71		
Attachment anxiety		.11 (.07)	.24, $p = .118$	.24, .50		
Step 3:	.82				.64	6.41, $p = .015$
BPD		2.18 (.84)	.42, $p = .014$	.47, 3.88		
Attachment avoidance		.03 (.04)	.07, $p = .52$	-.06, .11		
Attachment anxiety		.11 (.07)	.24, $p = .118$	-.04, .21		
Self-esteem		-.62 (.24)	-.282, $p = .015$	-1.11, -.125		

To further examine the relationship among BPD, self-esteem, and self-harm a simple mediation analysis using ordinary least square regression analysis was conducted between BPD and intent to self-harm, with self-esteem as the mediator. The results can be seen in Table 9.18, and a conceptual diagram of the model can be seen in Figure 9.4. The results show that those with higher levels of BPD features are more likely to report lower self-esteem (a = -1.38, $p < .001$), and self-esteem was associated with a reduced intent to self-harm (b = -.68, $p = .007$). A bias corrected bootstrap confidence interval for the indirect effects (ab = .93) did not contain zero (.46, 1.88), and the normal theory test (Sobel) was significant ($p = .017$). Notably, analyses revealed that a multiple mediation model including self-esteem, plus attachment avoidance and anxiety as mediators in the prediction of self-harm was not supported either by the normal theory Sobel test (.19, $z = .62$, *ns*, and .79, $z = 1.34$, *ns*, for avoidance and anxiety respectively) or 95% bootstrap confidence intervals, supporting the specificity of the model presented in Figure 9.4. It can therefore be concluded that the relationship between BPD and intent to self-harm after exposure to the vignettes is mediated to some extent by self-esteem.

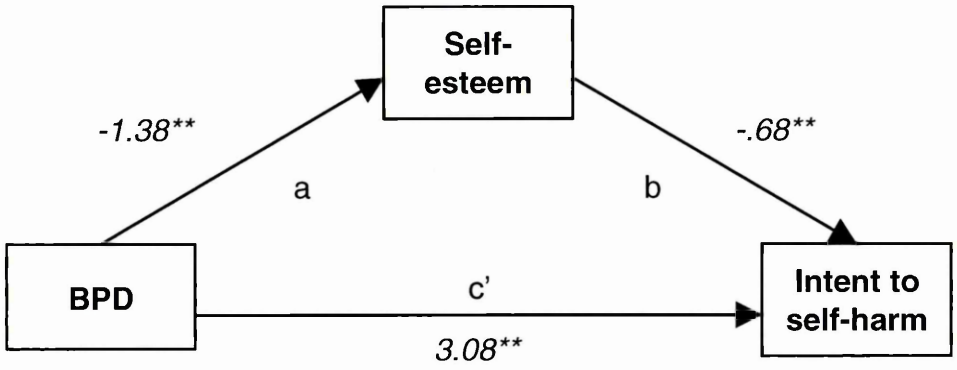

Figure 9.4 Conceptual diagram of BPD and intent to self-harm, mediated by self-esteem. *$p < .05$, **$p < .001$

Table 9.18 Mediation Analysis of BPD and Intent to Self-harm Mediated by Self-Esteem.

Effect	Coefficient (*SE*)	CI 95% Lower, Upper
Total	4.02 (.50), $p < .001$	3.00, 5.03
Direct	3.08 (.57), $p < .001$	1.93, 4.24
Indirect (mediation)	.93 (.38)	.46, 1.87

A moderation analysis was also conducted, to examine how the interaction between BPD and self-esteem may affect intent to self-harm. The results can be seen in Table 9.19 and illustrated in Figure 9.5. The graph was plotted using the 'pick-a-point approach' to probing interactions (Hayes, 2013) using the sample mean and 1 *SD* above and below. Low self-esteem is associated with increased intent to self-harm and high BPD features, and higher self-esteem appears to be a protective factor, particularly in those with high BPD features. Therefore it can be concluded that self-esteem also moderates the relationship between BPD features and intent to self-harm to some extent.

Table 9.19 Moderation Analyses of BPD and Self-esteem.

Predictor	Coefficient (*SE*)	CI 95% Lower, Upper
Self-esteem	-1.21 (.31), $p < .001$	-1.84, -.59
BPD	7.03 (1.65), $p <. 001$	3.71, 10.35
Self-esteem x BPD interaction	-.43 (.17)	-.77, -.08

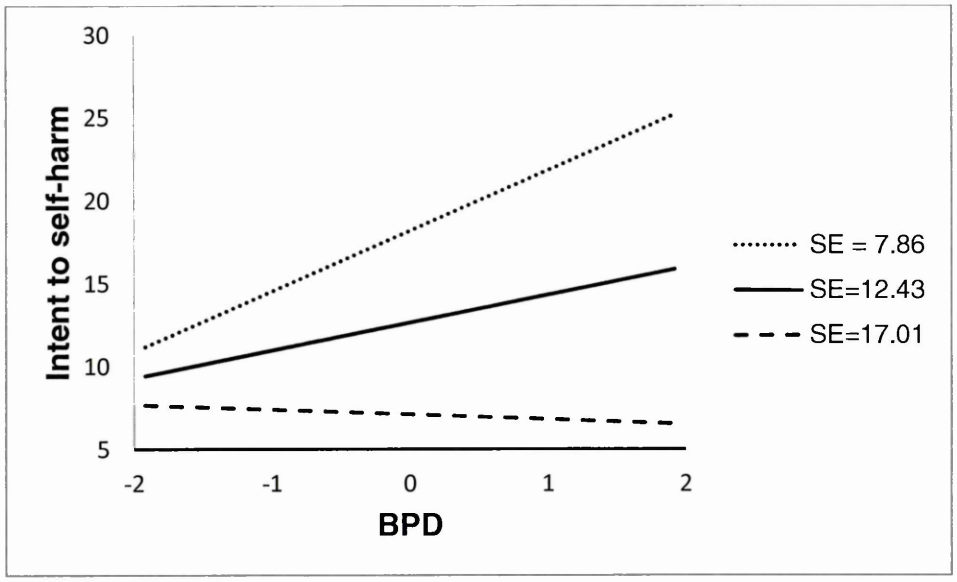

Figure 9.5 Moderation plot of self-esteem and BPD.

9.7 Discussion

The current study investigated the relationship among BPD features, executive functions and previous self-harm in a non-clinical sample. In addition, it was also explored if attachment insecurity and social cognition (as self and other-esteem) were related to intent to self-harm after exposure to rejection/abandonment-related stimuli. As hypothesised, individuals who reported self-harm sample demonstrated relatively high levels of borderline PD traits compared to controls. As in study 1, individuals who reported previous self-harm had significantly higher T-scores on the PAI-BOR measure of BPD which were comparable to that of a clinical sample (e.g., Jacobo et al., 2007), and the no self-harm group had T-scores which are generally consistent with a non-clinical sample (e.g., Gardner & Qualter, 2009; Trull, 1995). This further supports the current dimensional approach to psychiatric disorders and psychopathology, and the notion that meaningful results can be obtained from non-clinical samples. These findings further reproduce the strong association shown between BPD features and self-harm indicating that despite

possible differences between clinical and non-clinical BPD there are likely some shared processes that potentially transcend a BPD diagnosis in relation to self-harm.

Not consistent with the findings from Study 1 was that the self-harm group demonstrated no differences in self-reported attentional control components compared to the control group, but they did have significantly lower scores on the overall scale. It may be the case that the self-harm group have comparable attentional control to the control group, but attention is likely directed in some maladaptive way. For example, good attentional focusing might drive and/or maintain perseverative and anxiety inducing cognitions that ultimately lead to self-harm because the individual cannot switch attention 'off topic'. This is further supported by the findings from the Hayling sentence completion task section 2 (unconnected completion). The self-harm group generated a similar number of errors as the control group, suggesting that they can effectively suppress an incorrect response as well as the control group and are therefore not necessarily behaviourally impulsive, but likely have difficulty with the task for other reasons such as being unable to disengage attention from the correct response quickly.

There was partial support for the hypothesis that individuals who have previously self-harmed would exhibit executive function deficits compared to controls. The self-harm group were significantly impaired on the contrast variable of design fluency task compared to controls. This is consistent with the literature individuals with BPD show an inability to disengage attention from emotional stimuli, particularly in negative emotional conditions (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009).

The self-harm group had a significantly lower score on all measures of the Hayling Sentence Completion task (Burgess & Shallice, 1997) compared to controls.

However, the median scores on this task was generally average for the self-harm group, whereas the control group demonstrated superior performance overall (with a median score of 7, which is 'high average'), this suggests that the differences observed may be a result of superior performance in the control group rather than deficits in the self-harm group. Similarly, On the D-KEFS design fluency task which is a non-verbal measure of cognitive fluency Individuals in the self-harm group had a lower score on total number of correct designs and the condition 1 (filled dots) + condition 2 (empty dots) condition. However, as their performance appeared to be average, this difference again appears to be due to superior performance by the control group rather than deficits in the self-harm group. Although there were no significant differences in IQ between the self-harm and control groups, it is possible that the majority of the control participants were relatively higher-functioning individuals since they were recruited primarily from a university sample.

Analysis of performance on the Sorting Task indicated some impairment in initiation of problem-solving behaviour in the self-harm group compared to controls. This was not due to inhibition deficits or perseverative tendencies, but deficient conceptual reasoning and problem solving in both the perceptual and verbal domains. These findings indicate deficits in problem-solving that is consistent with research linking poor interpersonal and emotional problem-solving skills with self-injury in BPD (Linehan, 1993).

There were no significant differences in performance on the verbal fluency task for the self-harm group compared to controls, which was surprising since previous research has generally shown that higher verbal fluency performance is related to more successful regulation of emotional responses (Gyurak et al., 2012a). However this could be due to the majority of participants being women, since women

generally perform better than males in measure of verbal fluency (Weiss, Kemmler, Deisenhammer, Fleischhacker, & Delazer, 2003) generating more words and switches than males (Weiss et al., 2006).

Analysis of the attachment based-Stroop task analyses revealed that there were no differences in RTs between the two groups. This is somewhat surprising given that response inhibition (as measured by Stroop interference) has been closely linked to suicidal ideation and suicide risk in BPD (LeGris et al., 2012). There was a significant interaction when comparing self-harm to controls on accuracy for neutral words compared to positive words because the self-harm group were slightly more accurate, however this should be treated with caution due to the relatively small sample size and given that there were no other differences in RTs or accuracy. The Stroop task devised for this study included three categories of stimulus words (positive attachment-related words, negative attachment-related words, neutral words), which meant that it was not possible to separate out the effect of inhibition of emotional words from general inhibitory functioning. To address this limitation, future iterations of this Stroop task should include emotionally positive and negative words, rather than neutral.

Regression analyses on the primary measures of executive functioning suggested that EFs likely do not mediate or moderate the relationship between BPD and self-harm, but there was evidence of specific EF deficits that may contribute towards to BPD symptomology and self-harm, namely inability to disengage attention from emotional stimuli, deficient conceptual reasoning, and problem solving. This may represent cognitive inflexibility, which refers to the inability to change decision-making responses in response to feedback from the environment (Lezak et al., 2012). Cognitive inflexibility may lead to brooding in response to a negative mood,

because individuals with decreased mental flexibility may have difficulty disengaging from thoughts about the causes and consequences of their negative mood (Miranda, Valderrama, Tsypes, Gadol, & Gallagher, 2013). This difficulty seems to be particularly heightened in negative emotional conditions (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009)

Data from the current study also supported the hypothesis that participants who reported previous self-harm would report significantly higher attachment insecurity than controls. They scored significantly higher on avoidance and anxiety, and using Bartholomew's attachment styles there was increased fearful and occupied and reduced secure styles in the self-harm group. These findings add to the current body of knowledge on the role of attachment in self-harm behaviour, and are largely consistent with the majority of the research in this area that has identified attachment insecurity as a potential aetiological factor for self-harm (e.g., Glazebrook, Townsend, & Sayal, 2015; Gratz et al., 2002; Levesque et al., 2010; also see section 5.3). It is also consistent with the notion that individuals with insecure attachments are more likely to use maladaptive affect regulation strategies such as self-harm compared to those with secure attachment styles (Suyemoto, 1998).

A vignette task was created to test the hypothesis that social cognitive processing biases would be observed in the self-harm group as measured by reduced self and other-esteem, and an increased likelihood of self-harm after exposure to the abandonment and rejection related vignettes. The self-harm group did demonstrate significantly lower self-and other esteem ratings and higher likelihood of self-harm ratings compared to controls, after exposure to the vignettes. This is consistent with the literature that suggests deficits in social cognition may be

important contributing factors to self-injury (Williams et al., 2015). Regression analysis suggested that attachment orientation had no mediating or moderating effects on the relationship between BPD features and intent to self-harm, but rather it was self-esteem that had both a mediating and moderating effect on the relationship.

Mediation analysis showed that those with higher levels of BPD features were more likely to report lower self-esteem than controls, which was associated with an increased intent to self-harm. This indicates that self-esteem accounts for some of the relationship between BPD features and self-harm, Moderation analysis further suggested that low self-esteem is associated with increased intent to self-harm and high BPD features. Higher self-esteem appears to be a protective factor for intent to self-harm, particularly in those with high BPD features. Since self-esteem had both a mediating and moderating effect, these findings tentatively support the notion that social cognition is one of the mechanisms by which attachment orientation exerts its effects on BPD features (Williams et al., 2015). However, this is a tentative assertion, as a statistically significant mediated effect does not determine causality (Preacher & Hayes, 2004). In addition, a baseline measure of self-esteem was not included in the current study and so it cannot be concluded if reduced self-esteem occurred as a consequence of the vignettes or whether the self-harm group just had generally low self-esteem.

A further limitation of the study was that the analysis generally focused on group differences (self-harm vs. controls) and therefore are generalised to some extent. It could be argued that participants in their respective groups were not homogenous in their neurocognitive functioning, and therefore subtle deficits may not have been detected. One potential way of addressing this would be to examine

participant's performance on the D-KEFS on a case by case basis to generate specific profiles for individuals (Delis et al., 2001).

9.8 Summary

To summarise, the current study found that individuals who reported previous self-harm sample demonstrated relatively high levels of BPD traits compared to controls. There was no mediating or moderating effect of EFs on self-harm, but there was partial support for the hypothesis that individuals who have previously self-harmed would exhibit executive function deficits compared to controls since they demonstrated significantly poorer performance on some of the EF tasks, particularly deficits primarily related to problem solving, difficulty disengaging and switching cognitive sets. This may represent cognitive inflexibility whereby individuals brood or ruminate in response to a negative mood. Consequently, the feedback loop between rumination and negative affect continues, increasing in intensity and resulting in a highly negative and unpleasant emotional state resulting in an 'emotional cascade' (see section 2.2.2). This intense dysphoric state can result in self-harm as a way of ending the cascade and reducing negative affect (Selby & Joiner, 2009).

There were significantly higher levels of attachment insecurity in the self-harm group compared to controls, although attachment did not mediate or moderate the relationship between BPD features and future intent to self-harm, rather attachment insecurity may exert its effects via social cognitive processes. Lower self-esteem both mediated and moderated the relationship, which is consistent with the notion that social cognitive processes may contribute to self-harm and BPD features (Williams et al., 2015). Given that both executive and social cognitive deficits were present in the self-harm group, future research could examine whether neurocognitive impairments effect functioning via social cognitive impairments

(Green, Kern, Braff & Mintz, 2000; Schmidt, Mueller & Roder, 2011; Tully, Lincoln & Hooker; 2014).

Chapter 10 Study 3: Borderline Personality Features and Self-harm: Self-esteem, Attentional Control, and Adult Attachment as Mediators and Moderators

10.1 Overview of the Study

The results from previous studies indicated that the relationship between BPD features and self-harm are mediated and moderated to some extent by social cognitive processes, particularly low self-esteem in response to interpersonal cues of abandonment and rejection. Therefore, study 3 aims to explore this notion further by manipulating self-esteem to observe its effects on future intent to self-harm. Analysis showed increased levels of BPD features and attachment insecurity, and lower global self-esteem in the self-harm group compared to controls. There was evidence of executive function deficits in the self-harm group, as they demonstrated difficulties with the switching component of the plus-minus task. There was also evidence of social cognitive deficits, since the self-harm group reported significantly lower self-esteem and an increase in intent to self-harm after exposure to abandonment and rejection related vignettes. Furthermore, self-esteem and attachment anxiety together completely mediated the relationship between BPD features and self-harm. Supplementary material for Study 3 is included in Appendix E.

10.2 Linking study 2 and study 3

Findings from the previous studies indicated that EF deficits may play a role in BPD features and self-harm, but executive function did not influence the relationship between BPD and self-harm (either previous self-harm or future intent to self-harm). Instead, the results demonstrated that this relationship may be influenced by social

cognition in the form of low self-esteem in response to interpersonal cues of abandonment and rejection. Individuals with BPD features experience instability in self-image and interpersonal relationships (i.e., are prone to feel slighted or insulted) and suffer from a chronic fear of abandonment. Self-esteem in BPD is highly contingent on interpersonal feedback, and negative or overtly critical feedback can lead to a catastrophic decrease in self-esteem (Zeigler-Hill & Abraham, 2006). Therefore, one of the aims of this study is to investigate if self-esteem functions as a mediator (and moderator) of the relationship between BPD features and intent to self-harm in response to vignettes depicting abandonment and rejection related cues. In order to address some of the limitations of study 2, a baseline measure of self-esteem will be included, as well as manipulating self-esteem using false feedback, to observe its effects on future intent to self-harm

10.3 Introduction

Study 2 found evidence of executive function deficits in the self-harm group, since they demonstrated poorer problem solving skills and a persistent inability to disengage from stimuli and switch cognitive sets compared to healthy controls. There were also increased levels of attachment insecurity (avoidance and anxiety) in the self-harm group compared to controls. However, neither EFs nor attachment insecurity functioned as a mediator or moderator of the relationship between BPD features and self-harm. Instead, self-esteem functioned as both a mediator and a moderator of this relationship. It was suggested that attachment insecurity likely contributes to intent to self-harm indirectly, possibly via a reduction in self-esteem.

Sociometer theory (Leary, Tambor, Terdal & Downs, 1995) posits that the self-esteem system functions as a 'sociometer' that monitors the degree to which an individual is being included and accepted by others versus being excluded or

rejected. Other people's reactions exert a strong effect on self-esteem and so individuals are motivated to behave in ways that minimise rejection or exclusion. People who generally perceive that others reject or exclude them tend to have low self-esteem, whilst those who perceive that others accept or include them tend to have high self-esteem. In effect, the self-esteem system serves as a monitor/gauge of perceived inclusionary status.

Self-esteem is intimately connected with psychopathology. High levels of self-esteem are associated with an array of positive outcomes (e.g., academic achievement) and wellbeing, whereas low self-esteem is associated with a host of psychological disorders (Zeigler-Hill, 2011). For example the fragile and reactive self-esteem in BPD. Global self-esteem also influences the strategies that individuals adopt to further regulate their self-esteem, for example individuals with high self-esteem more likely to focus on strategies that further increase their self-esteem (self-enhancement). In contrast, individuals with low self-esteem are uncertain about their feelings of self-worth are therefore reluctant to risk rejection unless necessary because they are concerned with not losing the limited self-esteem they already possess (self-protection). Therefore, high self-esteem can function as a buffer from negative experiences, whereas those with low self-esteem are more likely to experience psychopathology due to a lack of resources (Zeigler-Hill, 2011). However, it is not clear if low self-esteem is a cause or consequence of psychopathology as the aetiology remains unclear

Individuals with BPD features possess unstable low self-esteem (Ziegler-Hill & Abraham, 2006) which is highly contingent on interpersonal feedback, and negative or overtly critical feedback can lead to a catastrophic decrease in self-esteem. Research has shown that individuals with BPD focus on self-esteem threatening

aspects of negative interpersonal situations (Zeigler-Hill & Abraham, 2006), which is not surprising given that the tendency to readily perceive or overreact to interpersonal rejection or abandonment is a defining feature of BPD (APA, 2013) and improving self-esteem is a goal of DBT (Linehan, 1993).

Low self-esteem has been associated with enhanced sensitivity to social feedback and reaction to rejection (Bungert, Liebke, Thome, Haeussler, Bohus & Lis, 2015). Individuals with high rejection sensitivity respond with accentuated aggression and withdrawal in situations of overt rejection (Zimmer-Gembeck & Nesdale, 2012), and the presence of current BPD features can accentuate the severity of rejection sensitivity (Bungert et al.). Increased rejection sensitivity may explain why individuals with BPD also interpret neutral or ambiguous interpersonal stimuli as negative (e.g., Meyer, Pilkonis & Beevers, 2004). A study by Bhatia and colleagues (2013) showed that increased levels of BPD features were associated with reporting a greater negative impact and greater emotional loss in response to partner-initiated daily romantic relationship experiences, and that these negative appraisals also extend to partner initiated positive romantic experiences. This suggests that BPD features are linked to a negative interpretation bias to both negative and positive experiences, specifically in partner initiated experiences. These consistently negative appraisals may underlie interpersonal dysfunction and low self-esteem in BPD (Bhatia et al., 2013).

Using the 'cyberball' paradigm (where participants exchange turns at ball throwing with computer-controlled confederates), De Panfilis and colleagues (2015) found that BPD patients exhibited higher levels of negative emotions and lower feelings of social connectedness than healthy controls in the ostracism condition (when they are not equally included in the ball throwing). However, they also

exhibited the same negative emotion and low social connectedness in the inclusion condition (when they were equally involved in ball throwing). The only condition in which BPD patients reported negative emotion and connectedness equal to HCs was in the over inclusive condition (when they were given more than equal turns in the ball throwing). This indicates that they may have a higher threshold for perceiving social inclusiveness, and even under conditions of extreme inclusiveness they are unlikely to feel as socially close to others as controls. Therefore, individuals with high BPD features are biased to react as if they were rejected even after objective inclusiveness (De Panfilis, Riva, Preti, Cabrino, & Marchesi, 2015)

The notion that self-esteem is responsiveness to one's social experiences is supported by neuropsychological evidence. A study by Onoda et al. (2010) demonstrated that individuals with lower trait self-esteem were more responsive to ostracism condition during 'cyberball' relative to those with high self-esteem, both in self-reported social pain and higher activity in the dACC region of the brain. Furthermore, individuals with both low self-esteem and low attentional control had a less advantageous pattern of neural response than those with low self-esteem but high attentional control in response to rejection themed images. Specifically, they had less activity in the emotional control regions of the right ACC region of the brain. This lack of activation resulted in rating rejection as more arousing and more rejecting than the high AC counterparts (Gyurak et al., 2012b). Therefore, attentional control may be a buffer against social rejection in those with low self-esteem, by facilitating faster disengagement from threatening stimuli.

Taken together, the evidence suggests that low and unstable self-esteem is prominent in BPD (Ziegler-Hill & Abraham, 2006), and that physiological and psychological responsiveness to rejection and social exclusion may be more

prominent in people with low self-esteem (Onoda et al., 2010). Furthermore, the presence of BPD features can further exacerbate this sensitivity to rejection and social exclusion (Bungert et al., 2015), which can lead to heightened physiological reactions and negative behavioural responses (Gyurak et al., 2012b). Rejection sensitivity may therefore represent a unique vulnerability for a number of maladaptive cognitions and behaviours following interpersonal rejection, which may be predictive of self-harm behaviour (Breines, & Ayduk, 2015).

This further supports the notion that the social cognition is particularly relevant in BPD and self-harm, because cognitive factors such as attentional control in conjunction with social cognitive deficits may represent a trait-like vulnerability for individuals who are at increased risk of self-harm (Williams et al.). Social cognition is related to, but distinct from, basic neurocognitive functions and appears to be a promising mediator of the relationship between neurocognition and functional impairments (Schmidt et al., 2011). Studies need to address the underlying alterations in social cognitive functioning in order to further improve therapeutic interventions (Bungert et al., 2015).

The initial aim is to replicate findings from previous studies and demonstrate that components of executive function (measured as attentional control and a switching task) along with BPD features would be associated with intent to self-harm in a non-clinical sample. Specifically, it is hypothesised that those individuals who report previous self-harm will exhibit higher BPD features, increased attachment insecurity, reduced global self-esteem, and executive function deficits compared to controls.

Consistent with Sociometer theory (Leary et al.), it was predicted that exposure to ambiguous/neutral false feedback would result in a decrease in self-

esteem compared to those who were given positive feedback. In addition, it was also predicted that there would be social cognitive processing biases in the form of increased intent to self-harm harm after exposure to the abandonment and rejection related vignettes because of reduced self-esteem. Finally, it is predicted that attachment insecurity and self-esteem may function as mediators and/or moderators of the relationship between BPD features and intent to self-harm after exposure to the vignettes.

10.4 Method

10.4.1 Participants.

A self-referring non-clinical sample of participants were recruited, via online mailing lists (Gardner, n.d.) and the Faculty of Development and Society PSYCREDS system; which rewards undergraduate students with research credits that fulfil part of the criteria of assessment for their research methods module. See Appendix E.2 for the Call for Participants flyer. A total of 119 participants were recruited, but three had to be excluded from the analyses since it was clear from the data that they had not understood the instructions for the plus-minus task. Consequently, there were 116 participants recruited and ages ranged from 18 - 65 (M = 23.62, SD = 8.65), 17 (14.7%) were men, 1 (.9%) was transgender and the remaining 98 (84.5%) were women. Of the total number of participants, 65 (56%) reported previous self-harm and the remaining 51 (44%) did not. The age and gender data did not meet parametric assumptions and so Mann-Whitney analyses was performed which showed that the two groups did not differ significantly on age (U = 1545.50, Z = -.63, p (exact sig. 2-tailed) = .53). Chi-square analyses showed that the two groups did differ significantly by gender (X^2 (2) = 12.49, p (exact, 2-sided) = .001), with there being significantly more females in the self-harm group.

10.4.2 Design.

The current study was an experimental design, whereby participants were alternately assigned into the neutral/ambiguously critical feedback condition vs. the positive feedback condition. Using a combination of self-report measures and a time cognitive switching task, the data will be collected online using a secure survey site (Qualtrics.com). One advantage of collecting data online is that it allows anonymity, which can partly address the problem of reluctance to disclose self-harm behaviour due to the shame that is often associated with it. Feeling ashamed may reduce the extent to which people who self-harm are willing to admit it to another person in an interview situation, compared with writing it anonymously on a questionnaire. A schematic diagram of the proposed study can be seen in Figure 10.1.

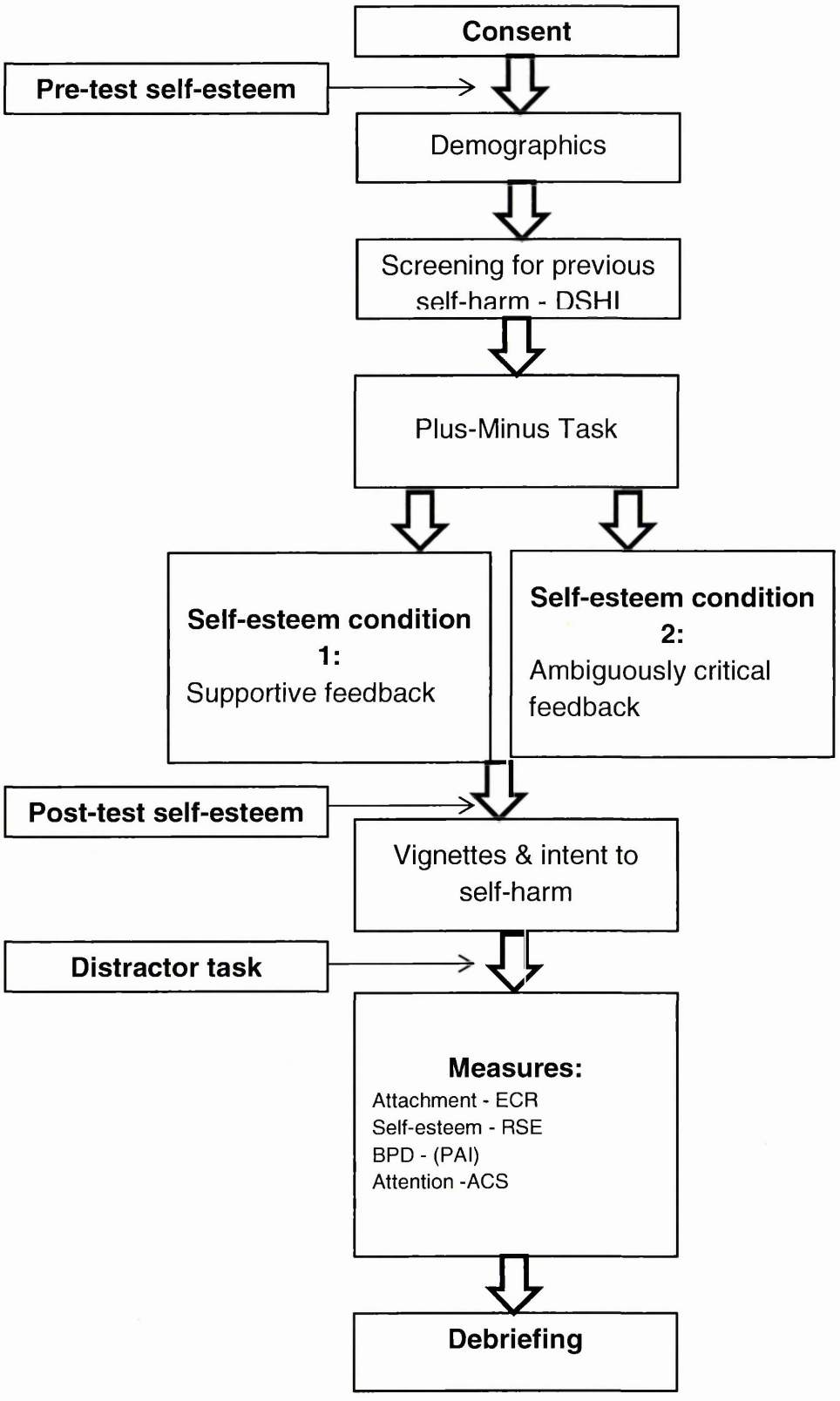

Figure 10.1 Schematic diagram of study 3

10.4.3 Materials and procedure.

The current research project was approved by the University's Research Ethics Committee (see Appendix E.1 for ethical approval). Informed consent was obtained via an information screen containing details of the study, issues of confidentiality and the right to withdraw (see Appendix E.3). All participants were debriefed upon completion of the study (see Appendix E.4 for the debriefing information). Importantly, the debriefing will advise participants that their feedback on the task was not a true measure of performance, but had been manipulated as part of the study. As this study also included a questionnaire about self-harming behaviours, it may be triggering for some participants'. Consequently, participants will also be given the telephone number and email address of the UK charity The Samaritans on screen during the debriefing, in case participation in the study raised any issues they wish to discuss with a mental health professional. The debriefing page also includes contact details for the university student wellbeing service that can provide appropriate and confidential advice and guidance to students and staff.

Potential participants recruited to the study progressed beyond the initial consent screen to provide gender and age and previous self-harm details. Participants then completed the Plus-Minus task, immediately afterwards they were alternately assigned by Qualtrics to either condition 1 (positive feedback) or condition 2 (ambiguously negative feedback). Participants were then given feedback on their performance. Participants were counterbalanced based on whether they reported previous self-harm or not, in order that each condition has a roughly equal number of participants who self-harm vs. those who do not. Following the feedback, participants will then be asked to complete the vignette task, and the following self-report measures.

10.4.3.1 Self-report measures.

As in the previous studies, attentional control was measured using The Attentional Control Scale (ACS) (Derryberry & Reed, 2002), which is a 20 item self-report measure of attentional control. The ACS (Fajkowska & Derryberry, 2010) has three subscales designed to tap the three dimensions of attention: attention focusing, shifting, and flexibility. In the current study, the focusing subscale demonstrated good internal consistency (α = .78), and shifting and flexibility subscale alphas demonstrated acceptable internal consistency for small scales (α = .55 and .69, respectively). The internal consistency for the overall scale was good (α = .83), and the Spearman-Brown split-half reliability coefficient for the overall ACS score was .83, which is generally considered adequate - high.

Self-harm was measured using item 1 of the Deliberate Self-Harm Inventory (DSHI - Gratz, 2001), which asks if participants have ever self-harmed, and if yes, when was the last time they did this. In addition to this there was also be a single-item measure of their intent to self-harm in the future: 'In general, how likely would you be to hurt yourself in the future?', whereby participants respond on a 6-point Likert scale ranging from 'Definitely would not' to 'Definitely would'.

The two attachment dimensions of anxiety and avoidance were measured using the 36-item Experiences in Close Relationships Questionnaire (ECR; Brennan, Clark, & Shaver, 1998). Both scales had good internal consistency (.94 and .96 for anxiety and avoidance respectively), and good discriminant validity as the two scales were not significantly correlated (r = .13, p = .07).

In this study there was only one measure of BPD features included (the PAI-BOR; Morey, 1991) to reduce participant burden. In the current study, the PAI-BOR demonstrated good internal consistency (α = .92, 24 items).

The current study will include The Rosenberg Self-esteem scale (RSES; Rosenberg, 1965) (see Appendix B.4) as a measure of trait self-esteem. The RSES is a 10-item measure of self-esteem, containing statements such as 'I feel that I'm a person of worth', and participants are asked to record their responses on a 4-point Likert scale ranging from 1 = Strongly agree to 4= Strongly disagree. The RSES is arguably the most widely used measure of global self-esteem and has been shown to have satisfactory psychometric performance in a diverse range of participants and contexts (Sinclair et al., 2010) and demonstrated good internal consistency in the current study (α = .92).

Additionally, there were state self-esteem measures, which will be used to measure pre-test and post-test self-esteem. These items were previously used in study 2 ("How do you feel about yourself right now?"; and 'I have high self-esteem right now'; adapted from Robins, Hendin, & Trzesniewski, 2001), and participants respond on a 6 point Likert scale ranging from 'not very true of me' to 'very true of me'.

10.4.3.2 Plus-minus task and feedback manipulation.

All participants completed the Plus-Minus task (based on Jersild, 1927 adapted from the work of Miyake and colleagues (2000). The Plus-Minus task is considered to tap the 'switching' component of executive functioning (Miyake et al.). Three lists of two-digit numbers (between 10 - 99) were randomly generated (without replacement, using SPSS), and presented to participants. For the first list, participants are asked to add 3 to each number, on the second list participants are asked to subtract 3 from each number, and for the third list, participants are asked to alternate between adding and subtracting 3 from each number. To make the task suitable for use online, participants were given one minute per list to complete as

many of the numbers as possible (as in St Clair-Thompson & Gathercole, 2006) rather than using the typical measure of time taken to complete each list. The cost of cognitive switching can then be calculated by the difference between the number of correct answers in the switching condition and the average of correct answers in the addition and subtraction lists.

Immediately after completing the Plus-Minus task, participants are given feedback on their performance. This is not true feedback, because participants were alternately assigned by Qualtrics to either condition 1 (positive feedback) or condition 2 (ambiguous/negative feedback). Participants are presented with a graph that purports to show the average reaction time of all participants who have participated so far, relative to their own performance. All participants are informed that their average reaction time was 640 milliseconds. In the positive feedback condition, participants are informed that they are 'in the top 10% of participants. Well done!', and in the ambiguously negative condition participants are told that they performed 'slightly slower than average for performance on this task' (see Appendix E.5, Figures E1 & E2 for the feedback graphs).

Distractor task - After the vignette task, participants will watch a brief 1 - 2 minute long humorous video clip, this is to distract their attention from the previous tasks and feedback so as not to influence their responses of the attachment, self-esteem, BPD and attention measures.

10.4.3.3 Vignette task and intent to self-harm.

A selection of vignettes will be used to portray various situations in which cues of abandonment and/or rejection are present in varying levels. Six vignettes were selected that contain cues of abandonment and/or rejection, as they are particularly BPD specific concerns (Veen & Arntz, 2000; Gunderson, 2009). The vignettes were

previously independently validated (see pilot study in Appendix D.5). Participants are asked to imagine themselves in the six scenarios, and then rate how likely they would be to hurt themselves. Participants respond on a 5-point Likert scale (1 = definitely would not; 2 =probably would not; 3 = don't know; 4 = probably would; 5 = definitely would). The intent to self-harm measures across all six vignettes had good alpha reliability (.91, 6 items).

10.5 Results

10.5.1 Descriptive statistics.

Initial analyses of the PAI-BOR T-scores for the no self-harm group (n = 51) ranged from 38 - 85 (M = 57.39, SD = 10.85) representing moderate elevation of personality traits, which is consistent with other non-clinical samples (e.g., Gardner & Qualter, 2009; Trull, 1995). Of the 51 participants, 7 participants (13.72%) had T-scores of 70 or above, which is considered to be the cut-off point that indicates presence of significant BPD features (Trull, 1995). T-Scores for the prior self-harm group ranged (n = 65) from 59 - 100 (M = 77.08, SD = 10.18), which is consistent with T-scores observed in clinical BPD samples (e.g., Jacobo et al., 2007). In addition, 47 participants (72.31%) had T-scores of 70 or above, likely reflecting problematic elevation of BPD features

Items relating to self-harm behaviours were then removed from the PAI-BOR to avoid collinearity with the outcome measure. The PAI with self-harm items removed had good alpha reliability (.90, 18 items). Scores for the PAI-BOR met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is one-tailed as it was predicted there would be higher levels of BPD features in the self-harm group. Levene's test for equality of variances was not significant, consequently equal variances were assumed.

Participants in the self-harm group had significantly higher BPD features compared to the no self-harm group as hypothesised and the effect size was very large (see Table 10.1), consistent with previous studies.

Table 10.1 BPD Features Compared Between groups

	No self-harm group	Self-harm group	
	Min - max Mean (*SD*)		Sig
PAI-BOR	4 - 47 20.65 (9.42)	21 - 51 36.32 (7.36)	$t(114) = -10.07$, $p < .001$, $d = 1.85$

For the Attentional Control Scale, all the subscales met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is two-tailed and can be seen in Table 10.2. Levene's test for equality of variances was not significant, consequently equal variances were assumed for all the subscales. The self-harm group had significantly lower scores on the focusing subscale and on the overall score, with medium to large effect sizes, but there were no differences in shifting or flexibility as in Study 1.

Table 10.2 Attentional Control Compared Between Groups

	No self-harm group	Self-harm group	
	Min - max Mean (*SD*)		Sig
ACS Focusing	11 - 35 22.90 (4.50)	9 - 30 18.98 (4.79)	$t(114) = 4.49$, $p < .001$, $d = .84$
ACS Shifting	10 - 24 16.75 (2.65)	8 - 23 15.85 (2.99)	$t(114) = 1.69$, $p = .09$,
ACS Flexibility	5 - 19 11.58 (3.01)	5 - 17 10.71 (3.15)	$t(114) = 1.52$, $p = .13$,
ACS overall	31 - 74 51.23 (8.27)	25 - 69 45.54 (9.36)	$t(114) = 3.42$, p <. 001, $d = .64$

For the ECR, both the anxiety and avoidance subscales met parametric assumptions, therefore comparison of means was via independent samples t-test, and significance reported is one-tailed as it was hypothesised there would be higher levels of attachment insecurity in the self-harm group compared to controls. Levene's test for equality of variances was significant for avoidance, consequently

equal variances were not assumed for that variable. The results can be seen in Table 10.3 and show that the self-harm group reported significantly higher avoidance (medium effect size) and anxiety (very large effect size) compared to those who had not previously self-harmed.

Table 10.3 Attachment Insecurity Compared Between Groups

	No self-harm group	Self-harm group	
	Min - max Mean (*SD*)		Sig
Attachment avoidance	18 - 87 52.47 (18.66)	24 - 116 62.57 (23.62)	$t(113.99) = -2.50$, $p = .007$, $d = .47$
Attachment Anxiety	18 - 121 63.59 (21.83)	44 - 125 89.28 (18.84)	$t(114) = -6.80$, $p < .001$, $d = 1.26$

The median scores overall for avoidance was 55.50, and 78.00 for anxiety. Using Bartholomew's attachment styles for descriptive purposes, in the control group 25 participants (49.02%) were secure, 7 (13.73%) were fearful, 14 (27.45%) were dismissing and 5 (9.80%) were preoccupied. In the self-harm group 10 participants (15.38%) were secure, 28 (42.08%) were fearful, 9 (13.85%) were dismissing and 18 (27.69%) were preoccupied. This is illustrated in Figure 10.2, and largely consistent with the findings from study 2, the fearful attachment style was more frequently reported by individuals who have previously self-harmed compared to controls, as was the preoccupied style. The trend was reversed for secure attachment, and there was little difference in the dismissing style.

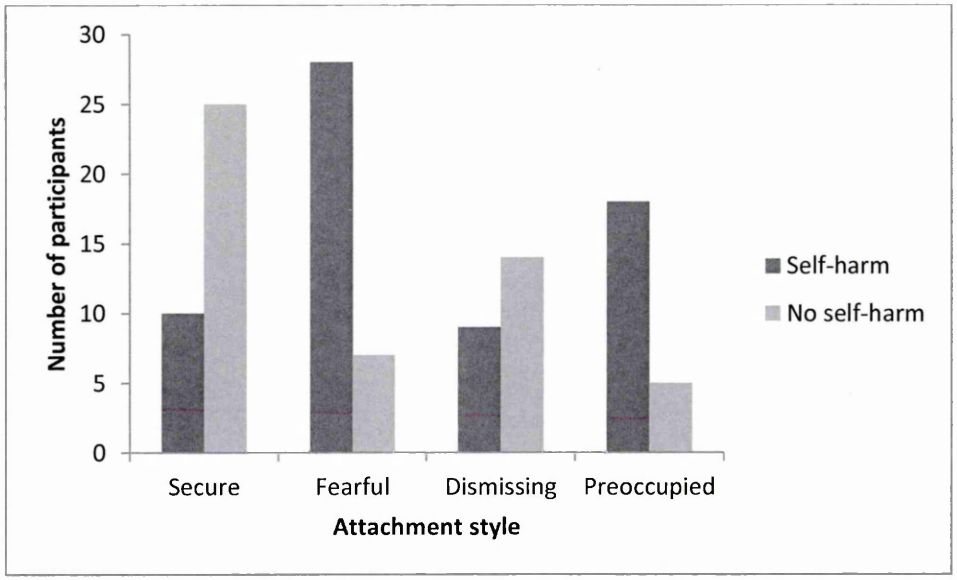

Figure 10.2 Attachment styles compared between groups

The RSE met parametric assumptions, therefore comparison of means was via independent samples t-test, and significance reported is one-tailed as it was hypothesised that lower levels of global self-esteem in the self-harm group compared to controls. Levene's test for equality of variances was not significant so equal variances were assumed. The results can be seen in Table 10.4 and show that the self-harm group had significantly lower trait self-esteem compared to those who did not, with a very large effect size.

Table 10.4 Trait Self-esteem Compared Between Groups

	No self-harm group	Self-harm group	
	Min - max Mean (*SD*)		Sig
RSES	4 - 30 20.04 (5.61)	0 - 25 12.20 (5.86)	$t(114) = 7.29$, $p < .001$, $d = 1.37$

For the Plus-Minus task, the Switching cost for each participant was calculated by the difference between the mean number of correct answers in the addition and subtraction lists and the number of correct answers in the switching

condition. The Plus-Minus task measures (Addition task correct answers, Minus task correct answers, Switching task correct answers and Switching cost) met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is one-tailed, as it was hypothesised that lower performance in the self-harm group compared to controls. Levene's test for equality of variances was significant for Addition task and so equal variances were not assumed for that variable. The self-harm group had significantly lower number of correct answers on the switching task and a higher switching cost (see Table 10.5).

Table 10.5 Plus-Minus Task Performance

	No self-harm group	Self-harm group	
	Min - max Mean (*SD*)		Sig
Addition task correct answers	8 - 36 19.73 (6.58)	10 - 35 20.18 (5.34)	$t(95.20) = -.40$, $p = .34$
Minus task correct answers	11 - 34 21.32 (5.26)	10 - 31 21.22 (4.80)	$t(114) = .11$, $p = .46$
Switching task correct answers	5 - 26 16.53 (5.73)	1 - 29 14.65 (6.46)	$t(114) = 1.64$, $p = .05$, $d = .31$
Switching cost	-1.50 - 21.50 3.99 (4.34)	-5.50 - 18.00 6.05 (4.60)	$t(114) = -2.46$, $p = .007$, $d = .46$

Pre and post-feedback self-esteem was measured immediately before and immediately after the Plus-Minus task. Pre-feedback intent to self-harm was the response to 'In general, how likely would you be to hurt yourself in the future?' and the post-feedback intent to self-harm was calculated by summing all the responses across all 6 vignettes. Both pre and post self-esteem and intent to self-harm measures met parametric assumptions, therefore comparison of means was via independent samples t-test. Significance reported is one-tailed as it was hypothesised that lower self-esteem and increased likelihood to self-harm in the self-harm group compared to controls. Levene's test for equality of variances was

significant for both pre and post feedback intent to self-harm and so equal variances were not assumed for those variables. The self-harm group had significantly lower self-esteem and higher intent to self-harm both pre and post feedback compared to controls, with relatively large effect sizes (see Table 10.6).

Table 10.6 Pre/post feedback Self-esteem and Intent to Self-Harm

	No self-harm group	Self-harm group	
	Min - max Mean (*SD*)		Sig
Pre-feedback			
Self-esteem	2 - 12 8.51 (2.49)	2 - 10 5.69 (2.14)	$t(114) = 6.55$, $p < .001$, $d = 1.21$
Intent to self-harm	1 – 3 1.33 (.59)	1 – 7 4.08 (1.62)	$t(84.23) = -11.48$, $p < .001$, $d = 2.26$
Post-feedback			
Self-esteem	2 - 12 8.49 (2.66)	2 - 12 6.26 (2.27)	$t(114) = 4.87$, $p < .001$, $d = .90$
Intent to self-harm	6 - 24 9.75 (5.35)	7 - 34 20.98 (7.02)	$t(84.23) = -9.48$, $p < .001$, $d = 1.80$

A multivariate analysis of variance was conducted to evaluate if the false feedback was successful in manipulating self-esteem. Preliminary assumption testing was conducted to check all variables for normality, linearity, outliers (using Mahalanobis distances), homogeneity of variance, covariance matrices and multicollinearity with no serious violations noted. There was a statistically significant difference between pre feedback and post feedback on self-esteem ratings ($F(2, 113) = 17.08$, p = <.001 Wilks' Lambda = .77, partial Eta^2 =.23). When the results for the dependent variables were considered separately, only the post feedback self-esteem rating reached statistical significance using the Bonferonni adjustment to reduce alpha level to .025 ($F(1, 114) = 9.58$, $p = .002$, partial $Eta^2 = .08$. An inspection of the means scores showed that pre-feedback self-esteem did not differ significantly, but there was a significant decreases in self-esteem for those who were

given ambiguous/neutral feedback ($M = 6.55$, $SD = 2.55$) compared to those who were given positive feedback ($M = 8.04$, $SD = 2.62$). This is illustrated in Figure 10.2.

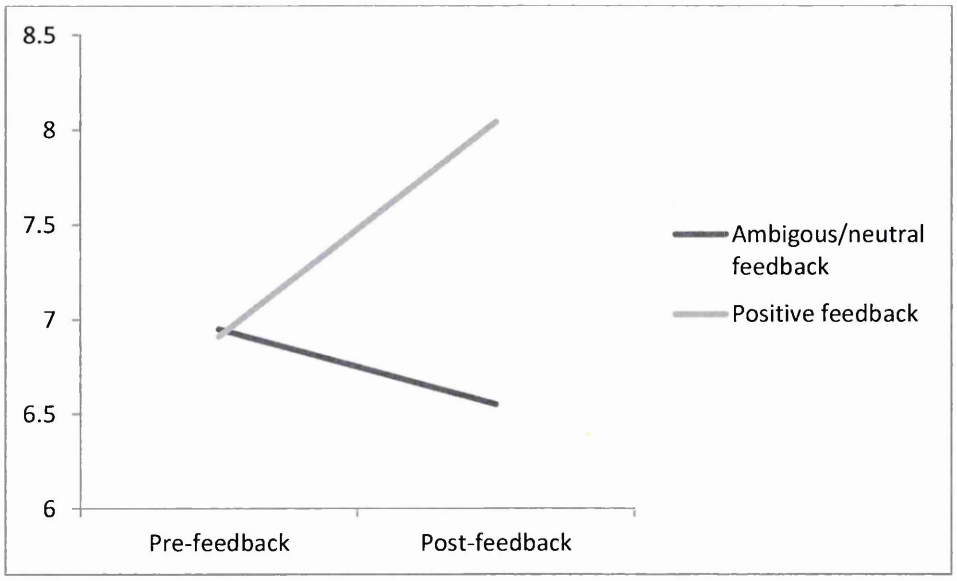

Figure 10.3 Pre and post-feedback self-esteem

10.5.2 Inferential statistics.

To examine what variables to select for further analysis, a Spearman's correlation analyses (2-tailed) was conducted to explore the relationships between intent to self-harm and BPD features (as measured by the PAI-BOR with self-harm items removed), executive function measures (self-report attentional control measured by the ACS, and the switching cost from the plus-minus task), attachment avoidance and anxiety (as measured by the ECR), and self-esteem (post-feedback self-esteem (contingent) and the RSE as a measure of global self-esteem). The results can be seen in Table 10.7. Intent to self-harm was significantly and positive correlated with BPD features and both attachment anxiety and avoidance, and was negatively correlated with the ACS overall and both measures of self-esteem.

Switching cost was not significantly related to BPD or intent to self-harm and so was not included in any further analyses. Other correlations of interest are that BPD features was highly correlated with attachment avoidance, but more so with attachment anxiety. In addition, both self-esteem measures (contingent and global) were highly correlated suggesting good convergent validity.

Table 10.7 Correlation Matrix

	Intent to self-harm	BPD features	Attentional control	Switching cost	Attachment avoidance	Attachment anxiety	Post-feedback self-esteem
Intent to self-harm	1						
BPD features	.62**	1					
Attentional control	-.31**	-.35**	1				
Switching	.01	.10	-.11	1			
Attachment avoidance	.21*	.35**	-.06	-.16	1		
Attachment anxiety	.58**	.74**	-.33**	.05	.13	1	
Post-feedback self-esteem	-.48**	-.49**	.30**	-.07	-.15	-.41**	1
Global self-esteem	-.63**	-.74**	.40**	-.04	-.35**	-.44**	.60**

A hierarchical multiple regression model was the used to examine the possible contribution of BPD features, attachment insecurity (as avoidance and anxiety), attentional control, and contingent and global self-esteem to intent to self-harm. Intent to self-harm was, therefore, the criterion variable. BPD was entered in the first step and explained 38% of the variance in intent to self-harm.

In order to reduce the number of variables entered in to the regression due to the relatively low sample size, the ACS Overall score was selected as the measure of attentional control to be entered in the second step, due to the correlation between it and the criterion variable. Both attachment avoidance and anxiety were entered in the third step, and the self-esteem variables entered into the final step of the regression to examine whether self-esteem would partially explain the association between BPD and previous self-harm over and above the other variables. Preliminary analyses were conducted for all variables to ensure there was no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity.

The results can be seen in Table 10.8. At the final step, it was found that the variables explained a significant amount of variance in intent to self-harm ($F(6, 109) = 17.32$, $p < .001$, $R^2 = .70$, R^2 adjusted = .49). In the final model, there were two significant predictors, attachment anxiety ($B = -.09$, $t = -2.37$, $p = .019$) and global self-esteem ($B = -.40$, $p = .005$). Attentional control did not significantly contribute to the variance. Interestingly, BPD features were a strong significant predictor of intent to self-harm until the final step, which suggests that attachment anxiety and global self-esteem may mediate or moderate the relationship between BPD features and intent to self-harm.

Table 10.8: Hierarchical Regression of BPD and Attachment Insecurity on Intent to Self-harm.

	R	Beta (*SE*)	Standardised Beta	95% CI Lower, upper	Adjusted R^2	*F*-change
Step 1:	.62				.37	69.70, $p < .001$
BPD features		.46 (.06)	.62, $p < .001$	.35 - .57		
Step 2:	.62				.38	1.97, ns
BPD features		.43 (.06)	.88, $p = .002$	.31 - .54		
Attentional control		-.10 (.07)	-.11, $p = .16$	-.22 - .06		
Step 3:	.65				.40	2.66, ns
BPD		.28 (.09)	.38, $p = .002$	.11 - .46		
Attentional control		-.08 (.07)	-.09, $p = .25$	-.22 - .06		
Attachment avoidance		.02 (.03)	.04, $p = .62$	-.05 - .06		
Attachment anxiety		.09 (.04)	.25, $p = .023$	.02 - .16		
Step 4:	.70				.46	7.48, $p < .001$
BPD		.09 (.10)	.13, $p = .34$	-.10 - .29		
Attentional control		-.02 (.07)	-.02, $p = .82$	-.15 - .12		
Attachment avoidance		.00 (.03)	.00, $p = .954$	-.06 - .06		
Attachment Anxiety		.09 (.04)	.25, $p = .023$	.02 - .16		
Global self-esteem		-.40 (.14)	-.33, $p = .005$	-.67 - -.12		
Contingent self-esteem		-.36 (.27)	-.11, $p = .192$	-.90 - .19		

10.5.3 Mediation and moderation analyses.

To further explore this, multiple mediation analysis was conducted using ordinary least square regression analysis between BPD and intent to self-harm, with attachment anxiety and global self-esteem as the mediators. All mediation and moderation analysis described in this section was carried out by the PROCESS macro for SPSS described by Hayes (2013), with bias-corrected bootstrap confidence intervals based on 5000 bootstrap samples. All coefficients are reported in their unstandardised forms. The results show that those with higher levels of BPD

features report lower self-esteem (a^1 = -.45, p < .001) and BPD features account for around 54% of the variance in self-esteem (r^2 = .54). Higher self-esteem is related to reduced intent to self-harm (b^1 = -.48, p < .001). Those with higher BPD features reported higher attachment anxiety (a^2 = 1.56, p < .001, with BPD accounting for around 55% of the variance in attachment anxiety (r^2 = .55). Increased attachment anxiety was related to increased intent to self-harm (b^2 = .09, p = .001). These results are represented in the conceptual diagram Figure 10.3.

A bias corrected bootstrap confidence interval for the indirect effect (ab = .36) was entirely above zero (.22, .50), and the normal theory test (Sobel) was significant for both attachment anxiety (p = .01) and self-esteem (p < .001). Both mediators and BPD features account for around 48% of the variance in intent to self-harm (r^2 = .48, p < .001). The direct effect of BPD features on intent to self-harm was not significant (b = .10, p = .30) which suggests that it does not contribute to intent to self-harm independent of the proposed mediators. A pairwise comparison between the specific indirect effects of self-esteem and attachment anxiety generated had confidence intervals that contained zero (-.22, .11), so it cannot be discerned if either mediating variable accounts for more variance in intent to self-harm than the other does.

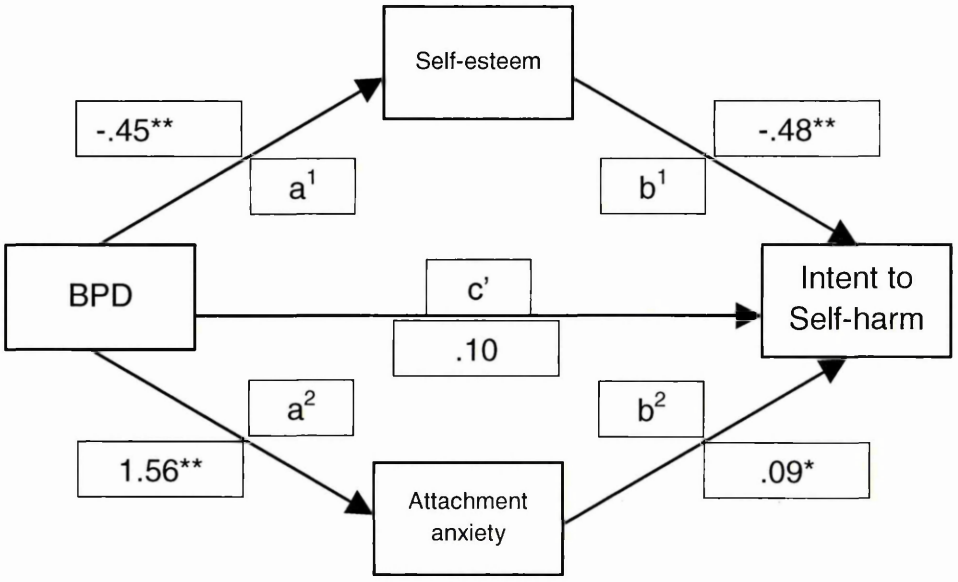

Figure 10.3 Multiple mediation conceptual diagram between BPD features and intent to self-harm, with self-esteem and attachment anxiety as mediators.

A moderation analysis was also conducted, to examine how the interaction among BPD, attachment anxiety, and self-esteem influence intent to self-harm ratings (see Table 10.9). There was no evidence that either attachment anxiety or avoidance moderated the relationship between BPD features and intent to self-esteem. The coefficients for the two interaction terms were not significant and bias-corrected 95% confidence intervals contained zero, suggesting that there is no moderation effect. This further supports the specificity of the mediation model illustrated in Figure 10.3.

Table 10.9 Moderation Analysis of BPD Features and Intent to Self-harm, with Self-esteem and Attachment Anxiety as Mediators.

Predictor	Coefficient (*SE*)	CI 95% Lower, Upper
BPD	.56 (.33), $p = .09$	-.09, 1.21
Attachment anxiety	.19 (.08), $p = .02$	.03, .35
Self-esteem	-.14 (.29), $p = .63$	-.70, .43
BPD x Attachment anxiety interaction	-.00 (.00), $p = .19$	-.01, .00
BPD x self-esteem interaction	-.01 (.01), $p = .20$	-.03, .01

10.6 Discussion

The findings from the current study were generally supportive of the hypotheses and demonstrated that individuals who reported previous self-harm (compared to controls) also reported significantly higher BPD features. This is consistent with findings from previous studies, and reproduces the strong association shown between BPD features and self-harm in a non-clinical sample. Compared to HCs, the self-harm group also reported significantly higher attachment avoidance and anxiety as hypothesised. This is consistent with findings from study 2, as is the finding of increased fearful and preoccupied and reduced secure styles in the self-harm group using Bartholomew's attachment styles. These findings further add to the current body of knowledge on the role of attachment orientation in self-harm behaviour, and are largely consistent with the majority of the research in this area that has identified attachment insecurity as a potential aetiological factor for self-harm (e.g., Glazebrook et al., 2015; Gratz et al., 2002; Levesque et al., 2010; also see section 5.3).

As hypothesised, the self-harm group also reported significantly lower global self-esteem and increased intent to self-harm after the vignettes. Self-esteem was manipulated via false performance feedback, and consistent with Sociometer theory (Leary et al.), ambiguous/neutral feedback resulted in a decrease in self-esteem compared to those who were given positive feedback. However, contingent (post-feedback) self-esteem did not contribute to intent to self-harm, a potential explanation for this is that the false feedback was performance-based, rather than containing any interpersonal related cues of ambiguous/negative feedback

One of the aims of the current study was to investigate if self-esteem functioned as a mediator (or moderator) of the relationship between BPD features

and self-harm. Mediation analyses supported the hypothesis that global self-esteem, along with attachment anxiety functioned as mediators of the relationship between BPD features and intent to self-harm after exposure to the vignettes. Global self-esteem and attachment anxiety completely mediated the relationship between BPD features and intent to self-harm, which suggests that BPD does not contribute to intent to self-harm independent of the proposed mediators but acts indirectly via self-esteem and attachment anxiety. An interpretation of these findings is that BPD features contribute to social cognitive processing biases in the form of reduced self-esteem, and that increased intent to self-harm harm after exposure to the abandonment and rejection related cues occurs as a result of low self-esteem.

The idea that BPD features appear to act indirectly on intent to self-harm via attachment anxiety and self-esteem is interesting. One interpretation of these findings is that the presence of BPD features likely indicates high attachment anxiety, and therefore causes higher levels of sensitivity to aversive stimuli, particularly to subtle cues of abandonment and rejection (Meyer et al., 2005; Roepke et al., 2012). This increased reactivity to interpersonally stressful situations (Lazarus et al., 2014), and consequent catastrophic decrease in self-esteem in the face of perceived negative feedback may lead to self-harm as a way of escaping the highly aversive negative affect (Korner et al., 2007; Linehan, 1993).

This is consistent with the literature, since previous studies have shown that attachment insecurity is a potential aetiological factor for self-harm (e.g., Glazebrook et al., 2015; Gratz et al., 2002; Levesque et al., 2010). Specifically, adult romantic attachment characterized by high anxiety over abandonment has been shown to influence the prevalence of self-harm related thoughts (Levesque et al., 2010). In addition, individuals with insecure attachments are more likely to use maladaptive

affect regulation strategies such as self-harm compared to those with secure attachment styles (Suyemoto, 1998). Consistent with findings from study two, the findings suggests that high self-esteem appears to be a protective factor against self-harm, particularly in those with high BPD features, whereas low self-esteem poses a risk factor. Therefore, it is possible that self-harm results from an interaction of high attachment anxiety and catastrophically low self-esteem.

Turning to look at the results of attentional control and EFs, individuals who reported previous self-harm reported significantly lower attentional focusing and had overall lower scores on the ACS compared to controls. This is consistent with the findings from the previous studies, which suggests that maladaptive attentional control might drive and/or maintain perseverative and anxiety inducing cognitions that ultimately lead to self-harm because the individual cannot switch attention 'off topic'. This is further supported by the results from the plus-minus task in which the self-harm group had significantly fewer correct answers on the Switching component of the plus minus task and a higher switching cost.

This is consistent with the literature that has shown that BPD features are associated with cognitive inflexibility, which can lead to rumination in response to a negative mood, because individuals with decreased mental flexibility may have difficulty disengaging from thoughts about the causes and consequences of their negative mood (Miranda et al., 2013) and this difficulty seems to be particularly heightened in negative emotional conditions (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009). This leads to an 'emotional cascade', whereby individuals self-harm as a way of ending the cascade and successfully (albeit temporarily) reducing negative affect (Selby & Joiner, 2009).

A limitation of the current study was that when manipulating self-esteem using the false feedback since it was not possible to include an overtly negative feedback condition. It was deemed ethically problematic given that it could potentially have led to an increase in intent to self-harm for some of the participants. It is possible that including overtly negative feedback could have resulted in an even stronger pattern of findings, but this would be difficult to explore given how reactive individuals with high levels of BPD features are to overtly critical feedback.

Another potential limitation is the use of self-referring participants. Participants were screened to ensure a roughly equal numbers in the self-harm group and control group, but there may still be a self-selection bias due to participants being attracted to the study because of the nature of the topic. However, given that individuals who self-harm are typically considered a difficult group to engage in research (Hawton & Sinclair, 2003; Clarke et al., 2004), the online methodology used in study 1 and in the current study has proven to be an effective way of targeting this population. Also consistent with the findings from the previous studies was that participants did endorse a high number of BPD features, particularly in the self-harm group. T-scores reflected that a number of participants in both the self-harm and non self-harm group reached the clinical cut-off point for a diagnosis of BPD.

Chapter 11 General Discussion

11.1 Overview of Chapter

In this chapter I present a brief summary of the studies that made up this research programme, followed by a general discussion of what the findings mean in the context of current knowledge and practice.

11.2 Summary of Studies

Summary of study 1: **Aim:** Investigate whether components of attentional control (shifting, focusing and flexibility) as measured by the ACS (Derryberry & Reed, 2002), along with BPD features, would be associated with self-harm likelihood in a non-clinical sample. **Rationale:** There is evidence to suggest that individuals with BPD have diminished executive functions; specifically they seem to exhibit deficits in attentional control and inhibiting maladaptive thoughts and behaviours. It has been suggested that they may self-harm in order to compensate for diminished affective/executive control, thus providing an outlet for emotional distress that cannot be regulated by normal cognitive and affective regulatory processes. However, less is known about what functions might contribute to self-harm in non-clinical groups with and without BPD features. **Results:** Attentional control factors, namely Focusing and Shifting, differentially moderated the association between BPD and rates of self-harm. For individuals low in BPD, high focusing ability appears to reduce the risk of self-harm, yet increase the risk for those high in BPD features. Whereas Shifting had little bearing on self-harm risk in those with pronounced BPD factors, but reduced shifting ability may pose a slightly elevated self-harm risk for those with moderate to low BPD features. **Conclusion:** The findings indicate that personality and attentional control factors interact to determine self-harm likelihood,

whereby high attentional focusing and shifting abilities are protective when BPD features are low. Conversely, high focusing may be a possible maintaining factor when BPD features are high. This finding seems to indicate that it is the content of attentional focusing rather than the process that may be pathological in those high in BPD features.

Summary of study 2: **Aim:** Extend the findings of study 1 by introducing a wider variety of executive function measures, specifically measures that tap cognitive fluency, inhibition, problem solving, and shifting of attentional sets, to investigate if (along with BPD features) they would be associated with self-harm likelihood in a non-clinical sample. In addition, attachment theory was proposed as a useful theoretical framework for understanding both the development of individual differences in EFs, and the aetiology and maintenance of BPD traits. Consequently, a self-report measure of attachment was included, alongside an experimental vignette approach (Atzmuller & Steiner, 2010) to study the extent to which intent to self-harm might vary as a function of attachment insecurity and social cognitive variables. **Rationale:** Deficiencies in EFs most likely contribute to the symptoms seen in BPD, and it seems plausible that these deficits also contribute to self-harm behaviour. A possible explanation for the findings of deficits in EFs in BPD and self-harm can be provided by attachment theory, as attachment experiences in infancy shape the early organisation of the brain (Schore, 1994; 2003a; 2003b). In addition, mental representations of the self and others are crucial to understanding personality disorder (Bowles & Meyer, 2008, Meyer & Pilkonis, 2005). Negative mental representations of the self and others can result in negative social cognitive processing biases, which have been identified as important contributing factors to self-injury (Williams et al.). **Results:** There was partial support for the hypothesis

that individuals who have previously self-harmed would exhibit executive function deficits compared to controls since they demonstrated significantly poorer performance on some of the EF tasks, particularly deficits primarily related to problem solving, difficulty disengaging attention, and cognitive switching. However, differences in EFs did not mediate or moderate the relationship between BPD features and self-harm. There were significantly higher levels of attachment insecurity in the self-harm group compared to controls, and the self-harm group demonstrated social cognitive processing biases as measured by reduced self and other-esteem, and an increased likelihood of self-harm harm after exposure to the vignettes. Furthermore, relationship between BPD and intent to self-harm after exposure to the vignettes is both mediated and moderated to some extent by self-esteem. **Conclusion:** The findings indicate that personality along with executive and social cognitive processes interact to determine self-harm likelihood. The findings contribute to the current body of knowledge that examines the interrelations among attentional, executive and emotion systems in BPD and self-harm.

Summary of study 3: **Aim:** Investigate if attachment insecurity and self-esteem mediates or moderates the relationship between BPD features and intent to self-harm. **Rationale:** Attachment insecurity has been linked with the social cognitive deficits seen in BPD. Specifically, self-esteem appears to be an important variable because self-esteem in BPD is generally low and highly contingent on interpersonal feedback **Results:** Global self-esteem and attachment anxiety completely mediated the relationship between BPD features and intent to self-harm. **Conclusion:** Findings further support the notion that executive/attentional deficits in conjunction with social cognitive deficits may represent a trait-like vulnerability for individuals who are at increased risk of self-harm (Williams et al.).

11.3 General Discussion

The overall aim of this collection of studies was to investigate possible shared mechanisms that function as mediators or moderators in the relationship between BPD and self-harm in a non-clinical sample. Specifically, the studies were designed to investigate both 'pure' cognitive processes (executive functions) and social cognitive processes (attachment-related self and other evaluations in an interpersonal context).

The findings from this research showed consistently high levels of BPD features in a non-clinical sample, particularly in individuals who self-harm. Standardised BPD T-scores reflected that a number of participants in both the self-harm and non self-harm group reached the clinical cut-off point for a diagnosis of BPD. These findings indicate that individuals in non-clinical samples can and do have relatively high, and problematic, levels of borderline PD traits. Research suggests that high BPD features (e.g., individuals who score above the clinically significant cut-off point of 70T on the PAI-BOR) are associated with poorer outcomes such as academic difficulties, meet criteria for a mood diagnosis, and experience interpersonal dysfunction, even within a nonclinical population (Trull, Useda, Conforti, & Doan, 1997).

The findings are generally consistent with the current view of personality disorders and psychopathology in general, which is moving towards a more dimensional approach (APA, 2010) which posits that most psychiatric disorders can be placed on a continuum between a complete absence of symptoms to extreme symptoms (Tyrer, 2009) and that meaningful results can be found beyond simply categorising individuals by presence or absence of a PD diagnosis (Fossati et al., 2004; Trull et al., 1990).

11.3.1 The role of executive functions in BPD features and self-harm.

It was proposed that executive functions might be one of the shared processes that potentially transcend a BPD diagnosis in relation to self-harm. Results from the self-report measure of attentional control (the ACS) were quite inconsistent, as in Study 1 good attentional focusing increased the likelihood of a prior self-harm history in those with high BPD features, whereas ability to shift attention was associated with a reduced likelihood of self-harm. This suggested that good attentional switching ability might provide a protective buffer against self-harm behaviour for some individuals. However, in Study 2, self-harmers reported significantly lower overall ACS scores than controls, but there were no differences on any of the individual subscales. In Study 3 the self-harm group also had significantly lower scores on the Focusing subscale and on overall ACS scores.

These findings have been discussed in more depth in their respective chapters, but these overall inconsistent results could be explained by problems with the ACS itself. For example, the Overall ACS scores and the Focusing subscale demonstrated generally good internal validity (alpha >=.7) across all three studies, but this was not the case for the Shifting and Flexibility subscales which consistently demonstrated lower than desired alpha levels. An interpretation of this in consistency may be the fact that it is currently not known how to best represent the apparent components of attentional control and how they are related. For example, some researchers have suggested that if internal validity is low, then a single factor structure may be the most representative (Fajkowska & Derryberry, 2010) whilst other research supports a dual factor structure for the ACS (Judah et al., 2014). This is in contrast to the original three factor structure proposed by Derryberry and Reed

(2002), which suggests that more research is needed to examine the extent to which attentional control is multi-faceted and how best it is represented.

As subjective self-reports of attentional control may differ from objective measures, in study 2 a number of standardised and validated executive function measures were included. On these measures of executive functioning, individuals who reported previous self-harm exhibited deficits primarily related to problem solving, disengaging attention, and cognitive switching. This may represent cognitive inflexibility whereby individuals display an inability to disengage attention from emotional stimuli, particularly in negative emotional conditions (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009). This can then lead to brooding or rumination in response to a negative mood (Miranda et al., 2013).

This strongly resembles the 'emotional cascade' model of self-harm proposed by Selby and colleagues (2008; 2009; 2015) whereby the continued feedback loop between rumination and negative affect results in a highly negative and unpleasant emotional state whereby a potent form of distraction such as self-harm is required to 'short circuit' the cascade (Selby & Joiner, 2009). As self-harm provides successful (albeit temporary) relief, it then becomes a reinforcing behaviour, which likely contributes to its repetitive nature (Briere & Gil, 1998).

Although executive deficits were linked to self-harm, EFs did not mediate or moderate the relationship between BPD features and self-harm, either on their own or when combined into an overall EF variable. This is not to say that the EFs do not play a role in self-harm and BPD features, but they do not appear to exert any influence on the relationship between the two.

11.3.2 The role of attachment and social cognition in BPD features and self-harm.

Findings relating to attachment orientation were relatively consistent across all studies. In the pilot study (see Appendix D.5), participants who had a secure attachment style gave higher ratings to (i.e., had a more positive appraisal of) the vignettes, and had lower self-reported BPD features compared to the other three attachment styles. Insecure attachment styles were associated with BPD features and more negative appraisals of the vignettes, particularly the preoccupied and fearful style, which rated the vignettes most negatively and reported the highest levels of BPD features. This is consistent with the research that shows BPD is associated with a primarily preoccupied style of attachment but may switch to a fearful style when views of others become negative (Meyer & Pilkonis). Furthermore, the findings showed that attachment anxiety functioned as a mediator of the relationship between BPD features and overall vignette ratings.

In both Study 2 and study 3, the fearful attachment style was more frequently reported by individuals who have previously self-harmed compared to controls, and the preoccupied style to a lesser extent. Conversely, individuals who did not report previous self-harm were more likely to report a secure attachment style. This further contributes to the literature that has identified attachment insecurity as a potential aetiological factor for self-harm (e.g., Glazebrook et al., 2015; Gratz et al., 2002; Levesque et al., 2010), and further supports the notion that individuals with insecure attachments are more likely to use maladaptive affect regulation strategies such as self-harm compared to those with secure attachment styles (Suyemoto, 1998).

In study 2, individuals who reported previous self-harm also demonstrated significantly lower self-and other esteem ratings and higher likelihood of self-harm

ratings after the vignettes compared to controls. Similarly, in study 3 the self-harm group also demonstrated significantly lower self-esteem ratings and higher likelihood of intent to self-harm ratings after exposure to the vignettes. In study 2, self-esteem had both a mediating and moderating effect on the relationship between BPD features and intent to self-harm, and this pattern was also observed in study 3 as global self-esteem, along with attachment anxiety functioned as mediators of the relationship between BPD features and intent to self-harm after exposure to the vignettes. This is consistent with the literature that suggests deficits in social cognition may be an important contributing factor to self-injury (Williams et al., 2015). Higher self-esteem appears to be a protective factor for intent to self-harm, particularly in those with high BPD features.

11.4 Implications of Research

One of the aims of this series of studies was to identify which particular EFs were implicated in playing a role in self-harm behaviour in order to inform treatment options for specifically targeted interventions or skills training. To that end, there was evidence of maladaptive attentional control, deficits in problem solving, and cognitive inflexibility were related to self-harm behaviour in a non-clinical sample of participants. These may therefore be important mechanisms of change to consider when treating self-harm.

Attentional control is conceptually similar to a number of therapeutic concepts, such as 'mindfulness', which is one of the key components of DBT (Linehan, 1993) and 'mentalization', which is a core part of Mentalization Based Treatment (MBT) (Eizirik & Fonagy, 2009). Mindfulness involves learning to control the focus of attention rather than the object being attended to (e.g., observing a thought as a thought or an emotion as emotion) non-reactively without attempting to change or

control it (Lynch et al., 2006). Similarly, in MBT, individuals are taught awareness and control of internal mental states (Eizirik & Fonagy, 2009). Despite the differences in the theoretical paradigms that underpin these different methods of therapy, they do overlap, since both teach skills that help individuals with BPD distract themselves from their negative emotional internal states (Levy et al., 2008). DBT has been shown to reduce repetition of self-harm in individuals with BPD (Hawton et al., 1998; 1999), and MBT has been shown to reduce self-harm better than treatment as usual in adolescents (Rossouw & Fonagy, 2012). It therefore seems that improving attentional control by teaching individuals to observe and describe emotions whilst decreasing attachment to emotional stimuli and sensations may result in shorter, more tolerable emotional reactions, therefore avoiding the need for self-harm (Lynch et al., 2006).

Furthermore, cognitive inflexibility (particularly attentional inflexibility in the form of difficulty switching attention from one set of thoughts to another) has been linked to rumination (Whitmer & Banich, 2007), which can further exacerbate negative emotions (Mikolajczak et al., 2009), resulting in self-harm (Selby & Joiner, 2009). Cognitive rigidity can make it difficult for an individual to identify adaptive coping mechanisms and can therefore lead to problem solving difficulties (Horrocks & House, 2002). When confronted with life stresses, individuals with rigid styles of thinking cannot deal with the situation effectively, consequently passive problem solving styles arise, which are less versatile and less problem focused (Horrocks & House). Problem solving therapy may therefore form part of an effective intervention for people who repeatedly self-harm (Hatcher, Sharon, Parag, & Collins, 2011). The current evidence tentatively supports the effectiveness of brief problem-solving

therapy for the reduction of self-harm (Collinson et al., 2014), but larger scale studies are desperately needed.

Relatively little research has examined the specific role of attachment and social cognition in self-harm behaviour, but current research suggests that individuals with insecure attachment organisation are more likely to use maladaptive affect regulation strategies compared to those with secure organisation (Schaffer, 1993; Suyemoto 1998). The findings from this series of studies are consistent with this, specifically the fearful attachment style was more frequently reported by individuals who have previously self-harmed compared to controls, and the preoccupied style to a lesser extent.

Therefore increasing levels of secure attachment may be an important goal of psychological therapy for treating self-harm. This is a positive finding because research has generally shown that it is possible to increase attachment security. For example a recent systematic review of studies looking at change in adult attachment during psychotherapy found that in the majority of studies, secure attachment increased during therapy and attachment anxiety decreased and was maintained up to 12 months after therapy (Taylor, Rietzschel, Danquah, & Berry, 2015). Geller and Farber (2015) argue that the role of the therapist is to provide insecurely attached clients with a secure base in which to safely explore and examine their thoughts and feelings and create new and more realistic self and other representations. However, further research is needed to identify key factors that lead to change in attachment orientation.

The findings also indicated that self-esteem might also be an important contributing factor to self-harm. Higher self-esteem appears to be a protective factor for intent to self-harm, particularly in those with high BPD features. This is perhaps

not surprising given that improving self-esteem is a core goal of DBT (Linehan, 1993). This is also consistent with the literature which has shown that individuals who self-harm demonstrate low self-efficacy, a higher tendency towards self-blame and more self-derogation than those who do not self-harm (Fliege, Lee, Grimm, & Klapp, 2009). Research has shown that high levels of self-criticism are linked to dysfunctional interpersonal relationships (Glassman et al., 2007), therefore low self-esteem may exacerbate lack of social support and maintaining use of self-injury as an effective affect regulation mechanism. Taken together, this suggests that Interventions aimed at improving self-esteem may protect against self-harm (O'Connor, Rasmussen & Hawton, 2009) and increasing secure maternal and peer attachments may help recovery from self-harm (Glazebrook et al., 2015).

The findings also revealed that BPD features and self-harm were related to more negative processing of cues of rejection and abandonment contained in a series of vignettes, supporting the notion that for some individuals negative or overtly critical feedback can lead to a catastrophic decrease in self-esteem. This has important implications for therapy, as individuals with high BPD features are vulnerable to any ambiguity in interpersonal feedback (Meyer et al., 2004), therapists must keep in mind that insecurely attached patients are especially sensitive to issues of separation and loss (Taylor et al., 2015) and should be mindful of expressing cues or rejection.

There is currently insufficient evidence on which to make firm recommendations about the most effective forms of individuals who self-harm (Hawton et al., 1999), highlighting the urgent need for more research in this area. However, findings from this series of studies have highlighted several therapeutic approaches and techniques that may be helpful for some individuals who self-harm.

For BPD it has been suggested that effective treatment requires an eclectic approach that integrates different evidenced based psychotherapeutic techniques according to individual patient needs (Beatson & Rao, 2014; Livesley, 2007; 2012), and the findings indicate that this is likely also the case for effective treatment of self-harm. Specifically, interventions aimed at modifying or increasing cognitive flexibility and problem solving abilities, alongside increasing attachment security may be potential mechanisms of change for treatment of BPD and self-harm.

11.5 Strengths and Limitations

One of the limitations of this series of studies was that the studies investigated the clinical concepts of BPD and self-harm in a non-clinical sample. Therefore, it is unclear to what extent these findings can be generalised to clinical populations with BPD. Although caution is advised in interpreting findings related to clinical constructs from non-clinical investigations, such an approach is not uncommon (e.g., Bowles & Meyer, 2008; Bowles et al., 2013 Dreessen et al., 1999; Meyer et al., 2005; Torgersen et al., 2001). In addition, BPD features appear to be relatively prevalent in non-clinical samples (Torgersen et al., 2001) and self-harm is common in non-clinical populations (Brickman et al., 2014; Drabble et al., 2014), with around a 4% prevalence rate in a general sample (Briere & Gil, 1998; Klonsky et al., 2014).

Additionally, many individuals who self-harm may not seek clinical treatment due to the secrecy and shame associated with the behaviour (Hawton & James, 2005), which is one of the reasons why individuals who self-harm are typically considered a difficult group to engage in research (Hawton & Sinclair, 2003; Clarke et al., 2004) and so less is known about how BPD features might drive self-harm in non-clinical groups. Therefore, one of the strengths of this research programme was that the online methodology proved to be an effective way of targeting this under-

investigated population. Never the less, future research could use the paradigms developed in this research programme to investigate cognitive and social cognitive processes in a clinical population.

Another potential limitation is the use of self-referring participants. In Study 1, 28% of the sample reported a previous history of self-harm, much higher than the 4% prevalence rate in the general population, and higher than the 21% prevalence rate typically found in a clinical sample (Briere & Gil, 1998). Subsequent studies were designed to keep the groups (self-harm vs. no self-harm) relatively equal in size, however there may still be a self-selection bias due to participants being attracted to the study because of the nature of the topic.

A further limitation was the reliance on self-report measures for some of the variables. For BPD features, self-report measures were used without an accompanying clinical interview, however this is a common approach and has yielded useful findings consistent with clinical constructs (e.g., Dreessen et al., 1999; Meyer et al., 2004). A range of self-report measures were used in order to reliably measure BPD features, specifically the PAI-BOR was included as it contains standardised T-Scores to which are calibrated with reference to a matched community sample to aid comparison. Furthermore, the SCID-II SQ was adapted for use with a non-clinical population by creating dimensional response scales.

11.6 Conclusion

The overall aim of this series of studies was to investigate possible shared mechanisms that function as mediators or moderators in the relationship between BPD and self-harm in a non-clinical sample. Specifically, the studies were designed to investigate both 'pure' cognitive processes (executive functions) and social cognitive processes (attachment-related self and other evaluations in an

interpersonal context). This research has made a unique contribution to knowledge in the form of novel use of stimuli to measure cognitive and social cognitive variables in an under-researched population.

The findings from this series of studies make important contributions to knowledge and theory. Across all studies, there were consistently high levels of BPD features in a non-clinical sample, particularly in individuals who self-harm. This further supports the current dimensional approach to psychiatric disorders and psychopathology, and the notion that meaningful results can be obtained from non-clinical samples. There was also a strong and consistent association shown between BPD features and self-harm indicating that despite possible differences between clinical and non-clinical BPD there are likely some shared processes that potentially transcend a BPD diagnosis in relation to self-harm.

Individuals who reported previous self-harm exhibited executive deficits primarily related to problem solving, disengaging attention, and cognitive switching compared to controls. Cognitive factors such as attentional control may represent vulnerability for individuals who are at increased risk of self-harm (Williams et al.). Specifically for attentional control, the findings suggest that more research is needed to examine the extent to which attentional control is multi-faceted and how best it is represented. However, executive functioning did not mediate or moderate the relationship between BPD features and self-harm.

What did appear to be an important mediator of that relationship was attachment insecurity and self-esteem. It was suggested that the presence of BPD features likely indicates high attachment anxiety, which therefore causes higher levels of sensitivity to aversive stimuli, particularly to subtle cues of abandonment and rejection (Meyer et al., 2005; Roepke et al., 2012). Unstable self-esteem is

prominent in BPD (Ziegler-Hill & Abraham, 2006) and responsiveness to rejection and social exclusion may be even more prominent in people with low self-esteem (Onoda et al., 2010), which can lead to heightened physiological reactions and negative behavioural responses (Gyurak et al., 2012b). Rejection sensitivity may therefore represent a unique vulnerability for a number of maladaptive cognitions and behaviours following interpersonal rejection, which may be predictive of self-harm behaviour (Breines, & Ayduk, 2015).

Social cognitive impairments may be further amplified by interpersonal distress (Williams et al., 2015). Since individuals with BPD have low distress tolerance (Linehan, 1993) and an inability to disengage attention from negative emotional stimuli (Bourke et al., 2008; Sieswerda et al., 2006; von Ceumern-Lindenstjerna et al., 2009), they may use self-harm as a way of escaping the highly aversive negative affect (Korner, Gerull, Stevenson, & Meares 2007; Linehan, 1993). Relatively little research has examined the specific role of attachment and social cognition in self-harm behaviour, so the findings from this research programme make an important contribution to this under-researched area and tentatively support the notion that social cognition may be the proximate link by which attachment orientation exerts its effects on BPD features (Williams et al., 2015).

Taken together, the findings also have important contributions to practise and psychotherapy. Increasing levels of secure attachment and self-esteem may be an important goal of psychological therapy for treating self-harm. Improving attentional control by teaching individuals to observe, describe, and decrease attachment to emotional stimuli and sensations may result in shorter, more tolerable emotional reactions therefore avoiding the need for self-harm (Lynch et al., 2006). Most of the current neuropsychological research on self-harm and BPD focuses on 'cold'

cognitive processes (like EFs), but these findings suggest that 'hot' emotion-related cognitive processes (social cognition, in other words) are also important. It is likely an interaction between the two, since in BPD EFs are particularly impaired if the person is in a negative emotional state. Future studies need to address the underlying alterations in social cognitive functioning, as it is essential in order to further improve therapeutic interventions (Bungert et al., 2015).

In conclusion, this series of studies set out to determine possible shared mechanisms that function as mediators or moderators in the relationship between BPD and self-harm in a non-clinical sample. Notwithstanding the limitations, the overall findings suggest that cognitive factors (such as attentional control) in conjunction with social cognitive deficits may represent a trait-like vulnerability for individuals who are at increased risk of self-harm (Williams et al., 2015). Self-harm is likely the outcome of complex interactions among temperamental predisposing factors, attachment experiences, and biases in cognitive-affective-motivational responses. This is further evidence that the interaction between biological vulnerability (e.g., EF deficits) and a suboptimal childhood environment (leading to insecure attachment patterns) is a core aetiological factor for BPD (Linehan, 1993; Fonagy & Bateman, 2008; Meyer & Pilkonis, 2005) and possibly self-harm. Therefore, a possible explanation for the fact why not everyone with BPD self-harms (and not everyone who self-harms has BPD) might be due to individual differences in attachment orientation, self-esteem, and executive functioning.

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Appendix A Summary of publications

A.1 Journal papers

Drabble, J., Bowles, D. P., & Barker, L. A. (2014). Investigating the role of executive attentional control to self-harm in a non-clinical cohort with borderline personality features. *Frontiers in Behavioral Neuroscience, 8.*

A.2 Conference abstracts

Drabble, J., Bowles, D. P., & Barker, L. (2012, September) Self-harm in a non-clinical cohort with borderline personality features: The role of executive attentional control. Poster session presented at the 2nd International Congress on Borderline Personality Disorder and Allied Disorders. Amsterdam, Netherlands.

Drabble, J., Bowles, D. P., & Barker, L. (2011, December) Self-harm in a non-clinical cohort with borderline personality features: The role of executive attentional control. Poster session presented at Sheffield Hallam University, Faculty of Development & Society Research conference.

Drabble, J., Bowles, D. P., & Barker, L. (2010 July) Attentional control as a mediator of self-harm in borderline personality disorder (BPD). Poster session presented at Sheffield Hallam University, Faculty of Development & Society Research conference.

Drabble, J., Bowles, D. P., & Barker, L. (2010, March) Attentional control as a mediator of self-harm in borderline personality disorder (BPD). Poster session presented at South Yorkshire Mental Health Research Day.

Drabble, J., Bowles, D. P., Meyer, B., Reidy, J. G., & Bell, T. (2010, July) Attachment insecurity, negative mood symptoms, and rejection expectancy among adults with borderline and avoidant features. Poster session presented at the 1st International Congress on Borderline Personality Disorder. Berlin, Germany.

Appendix B Self-report measures

B.1 Attentional Control Scale (ACS; Derryberry & Reed, 2002)

Please read the questions carefully and use the scale below to mark the option that best applies to you.

1 ..... 2 ..... 3 4			
Almost never	**Sometimes**	**Often**	**Always**

It's very hard for me to concentrate on a difficult task when there are noises around.	**1**	**2**	**3**	**4**
When I need to concentrate and solve a problem, I have trouble focusing my attention.	**1**	**2**	**3**	**4**
When I am working hard on something, I still get distracted by events around me.	**1**	**2**	**3**	**4**
My concentration is good even if there is music in the room around me.	**1**	**2**	**3**	**4**
When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.	**1**	**2**	**3**	**4**
When I am reading or studying, I am easily distracted if there are people talking in the same room.	**1**	**2**	**3**	**4**
When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.	**1**	**2**	**3**	**4**
I have a hard time concentrating when I'm excited about something.	**1**	**2**	**3**	**4**
When concentrating I ignore feelings of hunger or thirst.	**1**	**2**	**3**	**4**
. I can quickly switch from one task to another.	**1**	**2**	**3**	**4**
. It takes me a while to get really involved in a new task.	**1**	**2**	**3**	**4**
. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures.	**1**	**2**	**3**	**4**
. I can become interested in a new topic very quickly when I need to.	**1**	**2**	**3**	**4**
. It is easy for me to read or write while I'm also talking on the phone.	**1**	**2**	**3**	**4**
. I have trouble carrying on two conversations at once.	**1**	**2**	**3**	**4**
. I have a hard time coming up with new ideas quickly.	**1**	**2**	**3**	**4**
. After being interrupted or distracted, I can easily shift my attention back to what I was doing.	**1**	**2**	**3**	**4**
. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.	**1**	**2**	**3**	**4**
. It is easy for me to alternate between two different tasks.	**1**	**2**	**3**	**4**
. It is hard for me to break from one way of thinking about something and look at it from another point of view.	**1**	**2**	**3**	**4**

B.2 The Deliberate Self-Harm Inventory (DSHI; Gratz, 2001)

This questionnaire asks about a number of different things that people sometimes do to hurt themselves. Please be sure to read each question carefully and respond honestly. Often, people who do these kinds of things to themselves keep it a secret, for a variety of reasons. However, honest responses to these questions will provide us with greater understanding and knowledge about these behaviours and the best way to help people. Please answer yes to a question only if you did the behaviour intentionally, or on purpose, to hurt yourself. Do not respond yes if you did something accidentally (e.g., you tripped and banged you head on accident). Also, please be assured that your responses are completely confidential.

1.	Have you ever intentionally (i.e., on purpose) cut your wrist, arms, or other area(s) of your body (without intending to kill yourself)	Yes	No
	If yes, when was the last time you did this?		
2	Have you ever intentionally burned yourself with a cigarette?	Yes	No
	If yes, when was the last time you did this?		
3.	Have you ever intentionally burned yourself with a lighter or a match?	Yes	No
	If yes, when was the last time you did this?		
4.	Have you ever intentionally carved words into your skin?	Yes	No
	If yes, when was the last time you did this?		
5.	Have you ever intentionally carved pictures, designs, or other marks into your skin?	Yes	No
	If yes, when was the last time you did this?		
6.	Have you ever intentionally severely scratched yourself, to the extent that scarring or bleeding occurred?	Yes	No
	If yes, when was the last time you did this?		
7.	Have you ever intentionally bit yourself, to the extent that you broke the skin?	Yes	No
	If yes, when was the last time you did this?		
8.	Have you ever intentionally rubbed sandpaper on your body?	Yes	No
	If yes, when was the last time you did this?		
9.	Have you ever intentionally dripped acid onto your skin?	Yes	No
	If yes, when was the last time you did this?		

10.	Have you ever intentionally used bleach or oven cleaner to scrub your skin?	Yes	No
	If yes, when was the last time you did this?		
11.	Have you ever intentionally stuck sharp objects such as needles, pins, staples, etc. into your skin, not including tattoos, ear piercing, needles used for drug use, or body piercing?	Yes	No
	If yes, when was the last time you did this?		
12.	Have you ever intentionally rubbed glass into your skin?	Yes	No
	If yes, when was the last time you did this?		
13.	Have you ever intentionally broken your own bones?	Yes	No
	If yes, when was the last time you did this?		
14.	Have you ever intentionally banged your head against something, to the extent that you caused a bruise to appear?	Yes	No
	If yes, when was the last time you did this?		
15.	Have you ever intentionally punched yourself, to the extent that you caused a bruise to appear?	Yes	No
	If yes, when was the last time you did this?		
16.	Have you ever intentionally prevented wounds from healing?	Yes	No
	If yes, when was the last time you did this?		
17.	Have you ever intentionally done anything else to hurt yourself that was not asked about in this questionnaire?	Yes	No
	If yes, what did you do to hurt yourself?		

B.3 Experiences in Close Relationships Questionnaire (ECR; Brennan, Clark, & Shaver, 1998)

The following statements concern how you feel in romantic relationships. We are interested in how you generally experience relationships, not just in what is happening in a current relationship. Respond to each statement by indicating how much you agree or disagree with it. Circle the number that best applies, using the following rating scale:

1	2	3	4	5	6	7
Disagree Strongly			Neutral/ Mixed			Agree Strongly

	Disagree Strongly			Neutral / Mixed			Agree Strongly
I prefer not to show a partner how I feel deep down.	1	2	3	4	5	6	7
I worry about being abandoned.	1	2	3	4	5	6	7
I am very comfortable being close to romantic partners.	1	2	3	4	5	6	7
I worry a lot about my relationships.	1	2	3	4	5	6	7
Just when my partner starts to get close I find myself pulling away.	1	2	3	4	5	6	7
I worry that romantic partners won't care about me as much as I care about them.	1	2	3	4	5	6	7
I get uncomfortable when a romantic partner wants to be very close.	1	2	3	4	5	6	7
I worry a fair amount about losing my partner.	1	2	3	4	5	6	7
I don't feel comfortable opening up to romantic partners.	1	2	3	4	5	6	7
I often wish that my partner's feelings for me were as strong as my feelings for him/her.	1	2	3	4	5	6	7
I want to get close to my partner, but I keep pulling back.	1	2	3	4	5	6	7
I often want to merge completely with romantic partners, and this sometimes scares them away.	1	2	3	4	5	6	7
I am nervous when partners get too close to me.	1	2	3	4	5	6	7
I worry about being alone.	1	2	3	4	5	6	7
I feel comfortable sharing my private thoughts and feelings with my partner.	1	2	3	4	5	6	7
My desire to be very close sometimes scares people away.	1	2	3	4	5	6	7
I try to avoid getting too close to my partner.	1	2	3	4	5	6	7

	Disagree Strongly						Agree Strongly
I need a lot of reassurance that I am loved by my partner.	1	2	3	4	5	6	7
I find it relatively easy to get close to my partner.	1	2	3	4	5	6	7
Sometimes I feel that I force my partners to show more feeling, more commitment.	1	2	3	4	5	6	7
I find it difficult to allow myself to depend on romantic partners.	1	2	3	4	5	6	7
I do not often worry about being abandoned.	1	2	3	4	5	6	7
I prefer not to be too close to romantic partners.	1	2	3	4	5	6	7
If I can't get my partner to show interest in me, I get upset or angry.	1	2	3	4	5	6	7
I tell my partner just about everything.	1	2	3	4	5	6	7
I find that my partner(s) don't want to get as close as I would like.	1	2	3	4	5	6	7
I usually discuss my problems and concerns with my partner.	1	2	3	4	5	6	7
When I'm not involved in a relationship, I feel somewhat anxious and insecure.	1	2	3	4	5	6	7
I feel comfortable depending on romantic partners.	1	2	3	4	5	6	7
I get frustrated when my partner is not around as much as I would like.	1	2	3	4	5	6	7
I don't mind asking romantic partners for comfort, advice, or help.	1	2	3	4	5	6	7
I get frustrated if romantic partners are not available when I need them.	1	2	3	4	5	6	7
It helps to turn to my romantic partner in times of need.	1	2	3	4	5	6	7
When romantic partners disapprove of me, I feel really bad about myself.	1	2	3	4	5	6	7
I turn to my partner for many things, including comfort and reassurance.	1	2	3	4	5	6	7
I resent it when my partner spends time away from me.	1	2	3	4	5	6	7

B.4 The Rosenberg Self-esteem Scale (RSE; Rosenberg, 1965)

Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement.

4	3	2	1
Strongly agree	**Agree**	**Disagree**	**Strongly disagree**

. On the whole, I am satisfied with myself.	**4 3 2 1**
. At times I think I am no good at all.	**4 3 2 1**
. I feel that I have a number of good qualities.	**4 3 2 1**
. I am able to do things as well as most other people.	**4 3 2 1**
. I feel I do not have much to be proud of.	**4 3 2 1**
. I certainly feel useless at times.	**4 3 2 1**
. I feel that I'm a person of worth, at least on an equal plane with others.	**4 3 2 1**
. I wish I could have more respect for myself.	**4 3 2 1**
All in all, I am inclined to feel that I am a failure.	**4 3 2 1**
. I take a positive attitude toward myself.	

B.5 The Short Coolidge Axis Two Inventory (SCATI – Coolidge, 2001)

The statements in this questionnaire are to help you describe yourself as you see yourself. Some statements will seem strongly false and some statements will seem strongly true. Other statements will seem somewhere in between the extremes, and you are to choose whether they are more false than true or more true than false.

It is important that you try not to omit any answers. If the statement does not exactly apply to you, do your best to find the answer that most closely describes you.

Read each statement carefully. After each statement you will find four possible responses:

SF for Strongly False, **MF** for More False than True, **MT** for More True than False, and **ST** for Strongly True.

Circle the response that best describes you.

SF	MF	MT	ST
Strongly False	**More false than true**	**More true than false**	**Strongly True**

I am very afraid of being abandoned by someone.	**SF MF MT ST**
I tend to have intense but unstable relationships.	**SF MF MT ST**
I wonder who I am much of the time.	**SF MF MT ST**
I have been very impulsive in my spending money, sex, drug use, shoplifting, reckless driving, or binge eating.	**SF MF MT ST**
I have repeatedly made suicidal threats or gestures, or I have repeatedly hurt myself on purpose.	**SF MF MT ST**

B.6 The Positive and Negative Affect Schedule (PANAS - Watson, Clark, & Tellegan, 1988)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark in the appropriate answer in the space next to that word. Indicate to what extent you generally feel this way, that is, how you feel on the average.

Use the following scale to record your answers:

1	2	3	4	5
Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**

..... interested	**..... hostile**	**..... inspired**
..... distressed	**..... enthusiastic**	**..... nervous**
..... excited	**..... proud ...**	**..... determined**
..... upset	**..... irritable**	**..... attentive**
..... strong	**..... alert**	**..... jittery**
..... guilty	**..... ashamed**	**..... active**
..... scared	**..... afraid**	

Appendix C Supplementary material for Study 1

C.1 Ethical approval

Sheffield Hallam University

SHARPENS YOUR THINKING

Our Ref AM/AW/14-2010

10 June 2010

Jennifer Drabble
PhD researcher in Psychology.
Department of Psychology, Sociology, & Politics.
The Lodge,
Collegiate Crescent Campus,
Sheffield Hallam University

Dear Ms Drabble

Request for Ethical Approval of Research Project

The revisions to your research project entitled " Moderators of self-harming behaviours in borderline personality disorder" have been submitted for ethical review to the Faculty's rapporteurs and I am pleased to confirm that they have now approved your project with the proviso that the 'briefing page' is amended according to the suggestions in the attached document.

I wish you every success with your research project.

Yours sincerely

Ann Macaskill

Professor A Macaskill

Chair

Faculty Research Ethics Committee

C.2 Call for participants

I'm currently a PhD student at Sheffield Hallam University (under the supervision of Dr David Bowles), and I'm interested in self-harm behaviours and how they relate to personality styles. I'm looking for participants to take part in the first wave of my study, which is an online questionnaire that asks about your thoughts, feelings, and behaviours. Most of the questions are straightforward, and it is estimated this study should take between 10 - 15 minutes to complete. This study is completely anonymous; no identifying information is gathered at all, and so there is no possibility that the data you provide will be tracked or somehow traced to you. In addition, this study has been approved by the Sheffield Hallam University institutional ethical review board.

Please note that this study contains questions about self-harm, which you may find distressing and/or triggering. The section directly related to self-harm will be clearly marked, and you are under no obligation to answer any of the questions. So please take care and keep safe if you do decide to take part.
Thank you!

http://www.surveymonkey.com/s/6JD8H8C

C.3 Informed consent & participant briefing

Thank you for your interest in participating!

In this study, you will be asked to complete a number of questionnaires which ask about your thoughts, feelings, and behaviours. The aim of this study is to explore which psychological mechanisms and personality styles are related to self-harm behaviours. Most of the questions are straightforward, and it is estimated this study should take between 10 - 15 minutes to complete.

WARNING: This study contains questions about self-harm, which some may find distressing and/or triggering. The section directly related to self-harm will be clearly marked, and you are under no obligation to answer any of the questions. If you are negatively affected by any of the questions in this study and feel that you may require help, please contact the UK charity The Samaritans on +448457 90 90 90 or by email at jo@samaritans.org.

This study is completely anonymous; no identifying information is gathered at all. Therefore, there is no possibility that the data you provide will be tracked or somehow traced to you.

Consent statement:

I agree to take part in the above research project. I have read and understood the explanatory statement above. I understand that agreeing to take part means that I am willing to complete questionnaires asking me about my personality and personal attitudes, thoughts, and feelings (as well as some background information, such as age and gender).

I understand that any information I provide is anonymous and confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party. No identifiable personal data will be gathered or published.

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalised or disadvantaged in any way. Please note that you may choose to leave the survey at any time, even if you have already completed some of the questions. If you choose to leave the survey before completion, your data will be destroyed and not used in any subsequent analyses.

By proceeding and completing the questionnaire on the following pages, I indicate my consent to participate. I understand that I may withdraw my consent at any time, and that I may choose not to answer any or all questions and that I am under no obligation to complete the study.

If you have any further questions regarding your participation in this study, please contact the researcher at j.drabble@shu.ac.uk

If you decide to participate, please answer the question below, and click the 'Next' button when you are ready to begin.

C.4 Debriefing information

Thank you for taking part in this study, your participation is appreciated.

The aim of this study was to collect data to investigate how attention and certain personality types are related to self-harm behaviour.

If you feel you were negatively affected by any of the questions in this study and feel that you may require help, please contact the UK charity The Samaritans on +448457 90 90 90 or by email at jo@samaritans.org.

This study was completely anonymous; no identifying information was gathered at all. Therefore, there is no possibility that the data you provided will be tracked or somehow traced to you.

If you have any further questions, please do not hesitate to contact the researcher: j.drabble@shu.ac.uk

Thanks once again for your participation!

Jennifer Drabble
PhD student in Psychology
Sheffield Hallam University.

Under the supervision of Dr. David Bowles. d.p.bowles@shu.ac.uk

Appendix D Supplementary material for Study 2

D.1 Ethical approval

Sheffield Hallam University

Our Ref AM/SW/19-2013

Jennie Drabble
Psychology
Room J202 Oak Lodge
Collegiate Crescent Campus
8th July 2013

INTERNAL

Dear Ms Drabble

Request for Ethical Approval of Research Project

Your research project entitled "**Moderators of self-harming behaviours in borderline personality disorder**" has been submitted for ethical approval to the Faculty's reviewers and I am pleased to confirm that they have approved your project.

I wish you every success with your research project.
Yours sincerely

Professor A Macaskill
Chair
Faculty Research Ethics Committee

Office address :
Business Support Team
Faculty of Development & Society
Sheffield Hallam University
Unit 4, Sheffield Science Park
Howard Street, Sheffield, S1 1WB
Tel: 0114-225 3308
E-mail: DS-ResearchEthics@shu.ac.uk

D.2 Call for participants

Sheffield Hallam University

- **Do you live in Sheffield or surrounding areas?**
- **Are you over 18?**

We would like to hear from

We would like to invite you to participate in our research study on how executive functions and personality traits contribute to self-harm type

You will be required to fill in some questionnaires, which include questions about your experience of self-

For further information:
Contact Jennifer Drabble.

Any information you provide is confidential. This research has been reviewed and

Sheffield Hallam University

- **Want 2 hours worth of psycreds?**
- **Data collection in March & April**
- **On Collegiate campus**

Now recruiting 'healthy control' participants!

We would like to invite you to participate in our research study on executive functions and personality traits. By 'executive functions', we mean thought processes such as attention, memory, planning, and problem solving.

You will be required to fill in some questionnaires, which include questions about your emotions and relationships. You will also be required to complete some tasks with the researcher, and on a computer.

Eligibility criteria:

- Females aged 19 - 59
- Males aged 19
- No previously diagnosed mental health conditions
- Not currently taking any psychoactive medication

For further information:
Contact Jennifer Drabble.
Email: j.drabble@shu.ac.uk
Website: **www.tinyurl.com/shustudy**
Tel: 01142252434

Any information you provide is confidential. This research has been reviewed and approved by the Research Ethics Committee at Sheffield Hallam University.

Sheffield Hallam University

- **Do you live in Sheffield or surrounding areas?**
- **Are you over 18?**
- **Do you have experience of self-harm?**

We would like to hear from you!

Self-harm is a broad term that includes a wide range of behaviours. Generally, it refers to any kind of self-inflicted injury to your own body without suicidal intent. Some common types of self-harm include (but are not limited to) scratching, cutting, or burning the skin; causing bruises or broken bones; self-poisoning; and interfering with wound healing.

What is this project about?

We would like to invite you to participate in our research study on how executive functions and personality traits contribute to self-harm type behaviour. By 'executive functions', we mean thought processes such as attention, memory, planning, and problem solving.

What will I have to do?

You will be required to fill in a number of questionnaires which include questions about your background, mood, thoughts, relationships, and self-harm behaviours. You will also be required to complete some tasks on a computer with the researcher. All testing will take place on the Sheffield Hallam University campus and the process should not take more than 2 hours.

Any information you provide is confidential. This research has been reviewed and approved by the Research Ethics Committee at Sheffield Hallam University.

For further information:

Contact : Jennifer Drabble
Email: j.drabble@shu.ac.uk
Website: **www.tinyurl.com/shustudy**
Tel: 01142252434

Please take one

Contact:
J.drabble@shu.ac.uk
Or visit:
www.tinyurl.com/shustudy

D.3 Participant information sheet and informed consent

The role of executive functions and personality in self-harm.

Participant information sheet.

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it would involve.

Please note that this study contains question about self-harm, which some may find distressing and/or triggering.

What is the purpose of this study?

The aim of this study is to investigate how executive functions and personality traits are related to self-harm type behaviours. By executive functions we mean thought processes such as attention, memory, planning, and problem solving. The data you provide will primarily be used as the basis of the principal investigator's PhD thesis.

Why have I been invited?

You may have been invited to take part in this study because you have a history of self-harm. Alternatively, you may have received this invitation to be part of the 'control group'. That is, people who have been selected who do not have a history of self-harm, in order to provide data to be used as a comparison.

Do I have to take part?

Your participation is voluntary. You can leave the study at any time without being penalised or disadvantaged in any way, even if you have already completed some or all of the tasks. If you choose to leave the study before completion, your data will be destroyed and not used in any subsequent analyses. Please note that once data collection has been completed, all data will be anoynmised. You cannot withdraw your data after this, as we can no longer identify which data belongs to which participant.

What will I have to do if I decide to participate?

If you decide to participate in this study; you will be asked to fill in a number of questionnaires which include questions about your background, mood, thoughts, relationships, and self-harm behaviours. You will also be required to complete some tasks on a computer with the researcher. The process should not take more than 2 hours.

Who has reviewed the study?

This research project has been reviewed and approved by the Research Ethics Committee at Sheffield Hallam University.

What are the risks and advantages of participating?

Please note that this study contains questions and discussion about self-harm, which some may find distressing and/or triggering. Before participating, you should consider if discussing self-harm may put you at any risk. If you think this may be the case, then please do not volunteer to participate as your personal safety is paramount. If at any time you feel uncomfortable, you can refuse to answer any (or all) questions and withdraw from the study.

We cannot guarantee any direct benefits as a result of participating in this study, however you will help to inform future research and treatment interventions for self-harm.

Will my taking part in the study be kept confidential?

Any information you provide is confidential, and will only be available to the principal researcher. Once collected, the data you provide will be coded so as to be anonymous. No information that could lead to your identification will be disclosed.

Data will be stored securely on the premises of Sheffield Hallam University. Aggregated results may be published in academic journals and made available to the wider community by being deposited in appropriate data archives.

For further information about this research project, please contact the principal researcher Jennifer Drabble. **Email:** j.drabble@shu.ac.uk. **Tel:** 01142252434

Address: Sheffield Hallam University, 37 Clarkehouse Road, Collegiate Campus, Sheffield, S10 2LD

CONSENT FORM

Title of Project: The role of executive functions and personality in self-harm.

Name of Researcher: Jennifer Drabble

Please initial each box:

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information and ask any questions. ☐
2. I understand there may be discussion of sensitive topics, and that I can immediately terminate my participation at any point without giving explanation. ☐
3. I understand that all information I give will be confidential and only accessible to the research team. ☐
4. I understand that my participation is voluntary and that I am free to decline to answer any or all questions. I understand that I am free to withdraw at any time without giving a reason. ☐
5. I agree to take part in the above research project and give my informed consent for my data to be used in future publications. ☐

Name of Participant	Date	Signature
Name of Person taking consent	Date	Signature

D.4 Debriefing information

Debriefing sheet for participants.

Thank you for giving up your time to participate in this study! This study is investigating how cognition and personality traits are related to self-harm type behaviours.

If you have any concerns about your behaviour, you can contact your doctor/GP or a healthcare professional for advice. Alternatively you can contact the UK charity The Samaritans on +448457 90 90 90 or by email at jo@samaritans.org for anonymous advice.

If you are a student of Sheffield Hallam University and require guidance, you can contact the student wellbeing reception for guidance and advice via telephone on: 0114 225 2136 or by email: student.wellbeing@shu.ac.uk

Please direct any concerns or questions about this study to the principal researcher, Jennifer drabble in the first instance or the research supervisor Dr David Bowles if they cannot be addressed. Contact details are below.

Contact details and useful information:

Principal Researcher: Jennifer Drabble

PhD Researcher at Sheffield Hallam University

j.drabble@shu.ac.uk

Telephone: 01142252434

Under the supervision of: Dr. David Bowles

d.p.bowles@shu.ac.uk

D.5 Investigating the Role of Adult Attachment to Social Cognition in a Non-clinical Cohort with Borderline Personality Features - A Pilot Study

D.5.1 Overview of the Study

The aim of this pilot study was to develop and pilot two novel tasks, an attachment-based Stroop task and a vignette rating task. Alongside a self-report measure of adult attachment, an experimental vignette approach (Atzmuller & Steiner, 2010) will be used to study the extent to which vignette appraisal varies as a function of attachment insecurity. Results showed that both the vignette task and the Stroop task functioned as expected and are suitable for use in subsequent studies. Furthermore, attachment anxiety functioned as a mediator of the relationship between BPD features and overall vignette ratings. Further supplementary material for this pilot study is included in Appendix D.6.

D.5.2 Introduction

Attachment related processes such as internal working models of the self and others are central to understanding cognitive processes in personality disorders (Bowles & Meyer, 2008, Meyer & Pilkonis, 2005). Internal working models play a role in the processing of attachment-relevant social information (Dykas & Cassidy, 2011), because individuals are likely to use biased rules to process this information as a function of whether they have a secure or an insecure internal working model of attachment. In BPD, disturbed/insecure attachment results in incoherent and inconsistent negative self - other representations (Clarkin et al., 2007; Levy, 2005; Meyer & Pilkonis, 2005) whereby individuals distort interpretations and reactions to emotional information and social signals given by others (Beeney et al., 2015). These consistently negative appraisals may underlie interpersonal dysfunction and low self-esteem in BPD (Bhatia, Davila, Eubanks-Carter, & Burckell, 2013).

Alongside a self-report measure of adult attachment, the experimental vignette approach (Atzmuller & Steiner, 2010) will be used to study the extent to which intent to self-harm might vary as a function of attachment insecurity and social cognitive processes (as measured by self and other-esteem). A selection of vignettes will be used to portray various situations in which cues of abandonment and/or rejection are present in varying levels. Vignettes have been used in previous studies to elicit cognitive-affective-motivational reactions in individuals with various personality disorder features (Besser & Priel, 2009; 2010; Besser & Ziegler-Hill, 2010; Bowles & Meyer, 2008; Meyer et al., 2005). Six vignettes (see Appendix D.5) that have been reported in the literature to contain cues of abandonment and/or rejection were selected for use, because they are particularly BPD specific concerns (Veen & Arntz, 2000; Gunderson, 2009). Previous studies have shown that catastrophic interpretations of ambiguous and abandonment/rejection related stimuli are correlated with BPD features (Bowles et al., 2013).

A bespoke Stroop task using attachment-related words was created. The Stroop task is a classic neuropsychological task that measures inhibition processes (MacLeod, 1991). The rationale for creating an attachment-based Stroop task comes from previous studies that have used attachment-related stimuli to measure cognitive effort (Beckes et al., 2010; Edelstein & Gillath, 2008; Mohr et al., 2007; Rowe & Carnelley, 2003), demonstrating that individuals with BPD tend to show increased interference compared to HCs (LeGris et al., 2012; Sieswerda et al., 2006) especially for emotion related words (Black et al., 2009). In addition, Stroop interference is negatively correlated with suicide risk and number of lifetime suicide attempts (LeGris et al., 2012).

The aims of this study were twofold, firstly to develop and validate the two bespoke tasks (the vignette task and the Stroop task) for use in future studies. Secondly, to investigate if the relationship among BPD features, attachment insecurity, and social cognition. Specifically, it was hypothesised that BPD features would be associated with attachment insecurity, lower self and other esteem ratings, and more negative appraisals of the vignettes. Finally, it was hypothesised that attachment insecurity would mediate or moderate the relationship between BPD features and negative responses to the vignettes.

D.5.3 Method

D.5.3.1 Participants, materials, and procedure.

A total of 42 participants were recruited from across the university, 38 (90.48%) of which were women, and aged 23 - 35 (M = 30.00, SD = 5.10). The current research project was approved by the University's Research Ethics Committee (see Appendix D.1). At the same time as rating the words and completing the vignette tasks, participants were also asked to complete the following self-report measures:

As in study 1, BPD features were measured using the SCID-II-SQ (First et al., 1997) The SCID-II-SQ was chosen because in Study 1 it had higher internal validity than the SCATI (Coolidge, 2001), and less items than the PAI-BOR (Morey, 1991) which will reduce participant burden. The SCID-II-SQ was modified as from the original 'yes/no' response option to measure symptoms dimensionally on a 4-point response scale (0 = never or not at all; 1= sometimes or a little; 2 = often or moderately; 3 = very often or extreme) as in study 1, in order to capture the variance of BPD features (e.g., Bowles & Meyer., 2008; Dreessen et al., 1999; Meyer et al., 2005). The SCID-II-SQ had good internal reliability (α = . 89, 15 items).

The two attachment dimensions of anxiety and avoidance were measured using the 36-item *Experiences in Close Relationships Questionnaire* (ECR; Brennan, Clark, & Shaver, 1998). The ECR is a self-report questionnaire with a 7 point response scales ranging from 'Disagree strongly' to 'Agree strongly' that taps attachment avoidance (e.g., 'I prefer not to show a partner how I feel deep down') and attachment anxiety (e.g., 'I worry about being abandoned'). Both scales had good internal consistency, (.93 for both anxiety and avoidance respectively), and good discriminant validity as the two scales were not significantly correlated (the attachment avoidance subscale was skewed so Spearman's two-tailed correlations were performed ($r = .25$, $p = .11$).

D.5.3.2 Development and validation of the vignette task.

An experimental vignette approach (Atzmuller & Steiner, 2010) was used to study the extent to which intent to self-harm might vary as a function of attachment insecurity, or self and other-esteem. Six vignettes were chosen that portray various situations in which cues of abandonment and/or rejection are present in varying levels, as they are particularly BPD specific concerns (Veen & Arntz, 2000; Gunderson, 2009). The full text of the vignettes is included in Appendix D.6, but they are briefly summarised here.

Vignette one, the ambiguous dinner scenario, (Bowles & Meyer, 2008) describes an intimate situation which contains potential romantic rejection and abandonment cues, and was designed specifically to tap BPD specific core beliefs (e.g., fear of abandonment). Vignette two, the friendship abandonment scenario, (Sheets & Lugar, 2005) describes a situation in which a close friend rejects spending time with you in order to go out with other friends. This vignette taps the BPD specific core beliefs such as abandonment and rejection in relation to friendship

conflicts. Vignette three, high-level threat of rejection, and vignette four, low-level threat of rejection (Besser & Priel, 2010) depict two similar scenarios but differ on the intensity of the rejection cues. Vignette five, private rejection, and vignette six, public rejection (Besser & Ziegler-Hill, 2010) depict two similar scenarios but differ on whether the interpersonal rejection is public or private.

D.5.3.2.1 Procedure.

Data was collected using the Qualtrics website for ease of administration. Participants were given the instructions to:

"Please carefully read the story below. Try to really place yourself in the role described. Then, respond to the questions below each story. There are no right or wrong answers, simply indicate what you personally believe by circling a response on the scale below. Don't think too long about each question; simply indicate what seems true to you at the moment."

Participants were then asked to rate each vignette on how it affected their self-esteem (How would you feel about yourself in this situation?) and other-esteem (How would you feel about your partner/friend in this situation?), on a six-point Likert scale ranging from 'extremely positively' to 'extremely negatively'. Participants were also asked four further questions specific to each vignette (e.g., 'I would expect that my partner will warm up to the idea of a romantic evening later on' for the ambiguous dinner scenario) to measure the impact of the vignette on participants' cognitive and affective responses. The questions and rating scales are described in more detail in the following section (also see Appendix D.6.1, tables D6.1 – D6.6). Some questions were reversely worded, but for the purposes of analyses, lower scores indicate a more negative appraisal of the vignette.

The responses for each vignette were summed (including self and other esteem items) to produce an overall negative rating for each vignette. The results can be seen in Table D5.1. The scales for each vignette generally demonstrated internal consistency, except for vignette 6 (public interpersonal rejection), but this could be because a non-BPD sample may not perceive some or all of the cues present in the vignette and may not make excessively negatively appraisals. However, ratings for the vignettes generally suggests that they are a valid way of manipulating self and other esteem and are therefore suitable for use in future studies.

Table D5.1 Descriptive Statistics for the Vignette Rating Task

	Min-max Mean (*SD*)			Cronbach's α
	Self-esteem	Other-esteem	Overall negative rating	
Vignette 1: Ambiguous dinner scenario	1 - 5 2.21 (1.05)	1 - 5 2.02 (1.00)	6 - 32 19.14 (5.88)	.79
Vignette 2: Friendship abandonment scenario	1 - 4 1.83 (1.03)	1 - 3 1.45 (.63)	6 - 27 14.38 (4.90)	.70
Vignette 3: High-level threat of rejection	1 - 6 1.86 (1.20)	1 – 2 1.10 (.30)	6 - 19 11.12 (4.10)	.62
Vignette 4: Low-level threat of rejection appraisal	1 - 6 3.81 (1.44)	1 – 6 3.86 (1.44)	6 - 36 25.38 (8.14)	.95
Vignette 5: private rejection	1 - 5 1.52 (1.04)	1 – 3 1.12 (.40)	6 - 17 7.26 (2.44)	.63
Vignette 6: public rejection	1 - 3 1.31 (.60)	1 – 3 1.07 (.34)	6 - 21 9.52 (3.87)	.58

The full descriptive statistics of the vignette ratings can be seen in Appendix D.6.1. But for the purpose of examining to what extent the vignette task impacted on self and other esteem, all 6 self-esteem items were collapsed, as were the 6 other-esteem items to create an overall self and other esteem measure. The overall negative vignette response scale (6 vignettes x 6 response items) was also included. Descriptive statistics and alpha reliability can be seen in Table D5.2, self-esteem and

overall response to the vignette were internally valid, but the other-esteem measure had a much lower than desired alpha.

Table D5.2 Descriptive Statistics for the Self and Other Esteem scale, and Overall Negative Response to the Vignettes.

Scale	Min - max	Mean (*SD*)	Cronbach's α
Self-esteem overall	6 - 23	12.54 (4.48)	.77 (6 items)
Other-esteem overall	6 - 16	10.62 (2.28)	.32 (6 items)
Overall negative response	53 - 125	86.81 (19.56)	.88 (36 items)

D.5.3.3 Development and validation of the attachment-based Stroop task.

Three categories of stimulus words were used: positive attachment-related words (e.g., adore, trust); negative attachment-related words (e.g., abandon, reject) and neutral words (e.g., gate, table). There were 21 words in each category, making a total of 63 words overall. The attachment-related words were derived from studies that have previously used attachment-related stimuli to measure cognitive effort (Beckes et al., 2008; Mohr et al., 2007; Rowe & Carnelley, 2003) and words in each category were matched on length and as closely as possible on three measures of frequency of use in the English language. The neutral words were generated by matching emotionally neutral words, to the attachment-related words, again as closely as possible for length and frequency.

The British National Corpus (BNC; 2007) is a 100 million word collection of samples of written and spoken British English from the later part of the 20th century, allowing for comparison of words by use of frequency. The BNC data cited herein has been extracted from the British National Corpus Online service, managed by Oxford University Computing Services on behalf of the BNC Consortium. All rights in the texts cited are reserved. The Kucera and Francis (1967) written frequencies of occurrence in American English (K-F-FREQ) and the Thorndike-Lorge (1944) written

frequencies (T-L-FREQ) were taken from the MRC psycholinguistic database (Coltheart, 1981). Table D5.3 shows the minimum, maximum, and median length and frequencies for each group of words (See Appendix D.6.2, table D6.7 for complete frequency data).

Table D5.3 Minimum, Maximum, and Median Length and Frequencies for Each Group of Words.

	Length	BNC Freq	KF-Freq	TL-Freq
Positive words (n=21)				
Median	7	1409	21	172
Min-max	4 - 11	129 - 29568	1 - 234	10 - 1862
Negative words (n=21)				
Median	7	1427	17	157
Min-max	4 - 11	96 - 12228	1 - 195	7 - 1315
Neutral words (n=21)				
Median	7	1477	18	172
Min-max	4 - 11	214 - 19305	1 - 198	5 - 1325

Note: Data taken from the MRC psycholinguistic database (Coltheart, 1981).

The word frequency data was not normally distributed and therefore violated parametric assumptions, consequently a Kruskal-Wallis one-way ANOVA was performed on the positive, negative and neutral words to compare length and frequency. There were no significant differences (Asymp. sig reported) in word length (χ^2 (2) = .00, p = 1.0), BNC frequency (χ^2 (2) = .09, p = .96), K-F frequency (χ^2 (2) = .02=, p = .99) and T-L frequency (χ^2 (2) = .32, p = .85). This indicates that the words in the positive, negative, and neutral group are sufficiently matched on length and frequency and do not differ significantly.

D.5.3.3.1 Procedure.

For the word rating task, participants were given the following instructions: *"Words differ in the kinds of emotions that they can make people feel. You should read each word very carefully, and then please rate how negative or positive the word makes you feel."* They were then asked to rate each of the 63 words on a five-

point Likert scale to what extent they found the word to be 1= Very unpleasant, 2= Somewhat unpleasant, 3= Neutral, 4= Somewhat pleasant, 5= Very pleasant.

The full table of ratings for each word can be seen in Appendix D tables D6.8 – D6.10, but for the purposes of validating the materials, the ratings for each individual word were summed across each category (positive, negative, and neutral), overall group ratings and mean can be seen in Table D5.4.

Table D5.4 Overall Ratings for Words by Group (Positive, Negative, and Neutral)

	Min-max Mean (*SD*)	Overall rating Min - max Mean (*SD*)	Cronbach's α
Positive words	3.14 - 4.86 4.25 (.39)	66 - 102 89.21 (8.23)	.90 (21 words)
Neutral words	2.86 - 3.62 3.09 (.15)	60 - 76 64.90 (3.18)	.60 (21 words)
Negative words	1.14 - 2.24 1.65 (.26)	24 - 47 34.55 (5.36)	.77 (21 words)

Word rating data did not meet parametric assumptions, therefore a Friedman Test was performed to compare participant ratings of the emotional valance of the words in the positive, negative and neutral words groups. Results showed that there was a statistically significant difference in the ratings across the three groups of words (positive, negative, and neutral) ($\chi^2 = .84$, (Asymp.) $p < .001$). Post-hoc analyses using Wilcoxon Signed Rank Tests revealed a statistically significant (One-tailed, Asymp. sig reported) difference in the ratings given to the three groups of words. Negative words were rated significantly lower (thus more negatively) than neutral words and positive words, and the positive words were rated significantly higher (thus more positively) than negative words and neutral words ($z = -5.65$, $p < .001$ in all cases). This indicates that participants rated the positive, negative, and neutral groups of words as being significantly different in emotional valence and suitable for use in the Stroop task.

D.5.3.3.2 Stroop task Pilot study.

After the words had been independently validated for use, the Stroop task was generated using E-prime 2.0 computer software on a PC running Windows 7.0. All stimuli were presented in Courier New font, size 18, and in the centre of the screen. Participants completed a practice trial, followed by the experimental trial. Each word was present on the screen until the participant responded, and the interstimulus interval (a fixation cross) was presented for 1000ms between presentations of words. A diagram and screenshot of the Stroop task can be seen in Figure D5.1. Participants responded by pressing the appropriate key on the keyboard, 1 = Green, 2 = Blue, and 3 = Red, which measured the reaction time and accuracy (correct or incorrect) of their response. A reminder of the keys was displayed on screen continuously during both the practice and experimental trial, and coloured stickers were placed on the corresponding keys. Right-handed participants used the number pad on the right hand side of the keyboard, whilst left-handed participants used the number keys on the top-left of the keyboard.

The practice trial consisted of 1 cycle of 18 words, which included 6 words (thermometer, lighthouse, trumpet, book, contents, and avenue) presented in 3 different colours (green, blue, and red). These words were chosen for the practice trial because they do not appear in the experimental trial and were relatively emotionally neutral. Participants then continued to the experimental trial, which contained 189 words in total, 21 positive attachment-related words, 21 negative attachment-related words, and 21 neutral words, each of which were presented in all three colours. The task consisted of two cycles (1 cycle of 99 words, and 1 cycle of 90 words) with a rest break in the middle, the length of which was determined by the participant. The words were presented in a randomised order in each cycle.

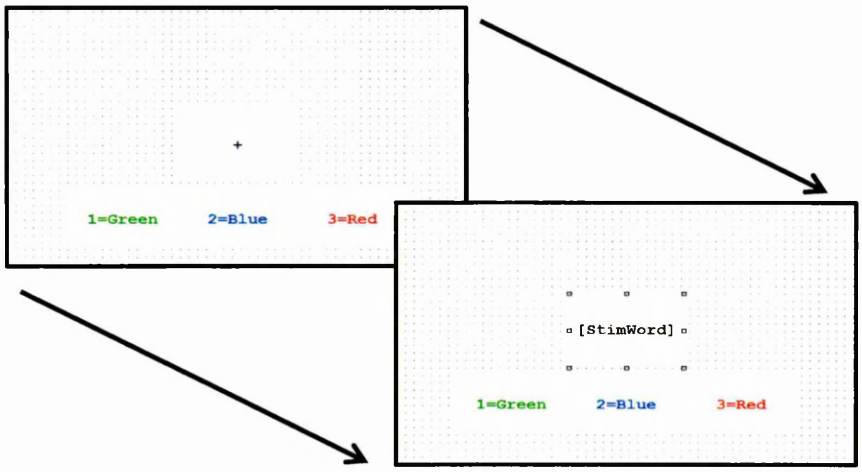


Figure D5.1 Screenshot of the Stroop task, showing the interstimulus interval and stimuli screen, respectively.

Five colleagues from the psychology department agreed to take part in a small pilot study to check that the task was functioning as intended and provide feedback on the design. Participants were verbally briefed that they would be participating in a Stroop task, in which they would be required to identify the colour of the ink the words was presented in. Immediately following this, participants were presented with the instruction screen for the practice trial:

"In this experiment, you should press the key that corresponds to the COLOUR that the word is displayed in as quickly and accurately as possible. There will be a practice trial before you move on to the proper test."

Participants are then instructed to press the space bar to continue on to the practice trial. Participants were not given any feedback on their performance in the task, but the experimenter observed the participant to ensure they were responding appropriately and understood the purpose of the task. After the practice trial, participants were then presented with a screen informing them to press the spacebar

when ready to proceed to the 'real trial'. After the first cycle of 99 words had been presented to participants, they were presented with a screen displaying the following:

"Almost finished! Please take a few moments to have a rest.

Press the spacebar when you are ready to continue."

The trial was suspended (length determined by the participant) until the participant was ready to continue, which was then followed by the second cycle of 90 words. When participants had finished the task, they were presented with a screen informing them that this was the end of the trial and that they should await further instructions from the experimenter.

The task worked as intended, and a response time and accuracy score was recorded from each participant for each word in each colour. There were 21 words in each category, making a total of 63 words overall and descriptive statistics for each group of words can be seen in Table D5.5. Median reaction times (RTs) for each category of words were calculated, and are displayed in milliseconds. Reaction times and accuracy scored were not normally distributed, consequently a Friedman's ANOVA test were conducted across the three word groups (positive, negative, and neutral) to test for an emotional Stroop effect. The test showed no statistically significant differences in RTs (χ^2 (2) = .32, (Asymp.) p = .85). A separate Friedman's test showed there were no significant differences in overall accuracy for each condition (χ^2 (2) = 2.8, p = .25). Typically an emotional Stroop effect would be expected in which participants are slower or less accurate for emotional stimuli compared to neutral, however the failure to find an emotional Stroop effect is likely due to an exceptionally small number of participants (N = 5). A manipulation check was also carried out to make sure there was no effect of colour on RTs or accuracy. Two Friedman's test was conducted across the three colour groups (red, blue, and

green) and showed no statistically significant differences in median RTs (χ^2 (2) = .40, (Asymp.) p = .82) or overall accuracy (χ^2 (2) = 5.78, (Asymp.) p = .06).

Table D5.5 Reaction Times and Accuracy for Each Group of Words (Positive, Negative and Neutral) (N = 5)

	Min - max RT	Median RT (range)	Overall mean accuracy
Negative words	429 - 492	448 (63.00)	62.40
Positive words	443 - 492	445 (49)	61.80
Neutral words	452 - 476	466 (24)	60.80

D.5.4 Results

D.5.4.1 Descriptive statistics.

The descriptive statistics for each individual vignette can be seen in Table D5.1, but for subsequent analyses all 36 items were collapsed to produce an overall negative vignette response scale (6 vignettes X 6 response items) as it incorporates both self-and other esteem and had the highest alpha level. Low scores indicate a more negative appraisal of the vignette. Descriptive statistics and alpha reliability for the BPD measure, attachment subscales, and overall vignette rating can be seen in the Table D5.6. Attachment anxiety was normally distributed, but Attachment avoidance and SCID scores were skewed (skewness >= standard error of skewness[2]).

Table D5.6 Descriptive Statistics for BPD and Attachment Measures.

	Min - max	Mean (*SD*)	Cronbach's α
SCID-BPD	18 - 49	27.17 (7.28)	.89 (15 items)
ECR avoidance	20 - 110	51.50 (23.00)	.96 (18 items)
ECR anxiety	20 - 119	69.21 (21.72)	.93 (18 items)
Overall negative response	53 - 125	86.81 (19.56)	.88 (36 items)

Spearman's correlations were performed, and one-tailed significance is reported as it was hypothesised positive relationships among BPD features and

attachment insecurity; and negative relationships between BPD features and overall vignette ratings, and a negative relationship between attachment insecurity and overall vignette ratings. As expected, there was a significant positive relationship between BPD features and both attachment anxiety ($r = .59$, $p < .001$) and attachment avoidance ($r = .44$, $p = .002$), and a negative relationship between BPD features and overall negative vignette ratings ($r = -25$, $p = .05$). There was also a significant negative relationship between attachment anxiety and overall vignette ratings ($r = -.38$, $p = .007$) but the relationship between attachment avoidance and overall vignette rating was not significant ($r = -.24$, $p = .061$). Attachment anxiety and avoidance did not correlate significantly ($r = .25$, $p = .052$) demonstrating the orthogonality and divergent validity of the constructs.

Although the authors of the ECR strongly suggest that variations in attachment are best modelled with dimensions rather than categories (e.g., Fraley & Waller, 1998), individuals can assigned to Bartholomew's attachment styles for descriptive purposes using the algorithm freely available from the official ECR website (http://www.psych.uiuc.edu/~rcfraley/measures/brennan.html#scoring). Participants are assigned to the 'secure' attachment group if both their anxiety and avoidance score is <= median, they are assigned to the 'fearful' group if both their anxiety and avoidance scores are >= median, they are assigned to the 'dismissing' group if their anxiety score is <= median and their avoidance score is >= median, and they are assigned to the 'preoccupied group if their anxiety score is >= median and avoidance score is <= median. The median scores for avoidance were 45.50, and 66.50 for anxiety. Of the 42 participants, 14 (33.3%) were classified as secure, 14 (33.3%) were fearful, 7 (16.7%) were dismissing, and 7 (16.7%) were preoccupied.

Figures D5.2 and D5.3 shows the overall vignette ratings and BPD features across each attachment style, respectively. Participants in the secure category gave higher ratings (i.e., more positive ratings) to the vignettes and had lower self-reported BPD features compared to the other three attachment styles. The dismissing category rated the vignettes more negatively than the secure group, but higher than the fearful or preoccupied group, and they reported more BPD features than the secure group but less than the fearful and preoccupied groups. The fearful group rated the vignettes more negatively than the secure and dismissing but not as negatively as the preoccupied group and they reported higher BPD features than the secure and dismissing group but not as high as the preoccupied group. Finally, the preoccupied group gave the lowest (e.g., most negative) ratings to the vignettes of all the groups and had the highest level of BPD features. This is consistent with the research that shows BPD features are associated with a primarily preoccupied style of attachment but may switch to a fearful style when views of others become negative (Meyer & Pilkonis); and that attachment insecurity is associated with a more negative appraisal of the vignettes.

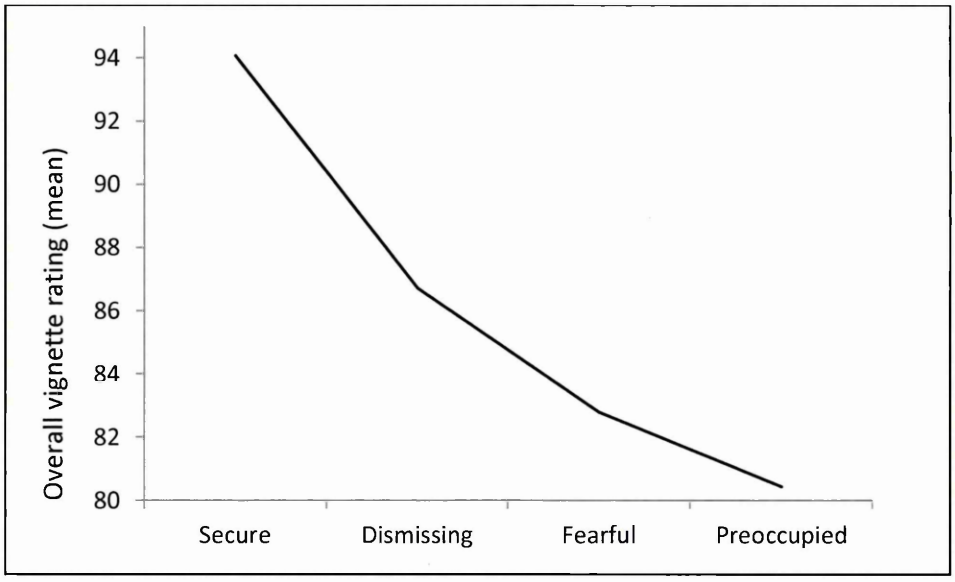


Figure D5.2 Mean vignette ratings across the four attachment styles.

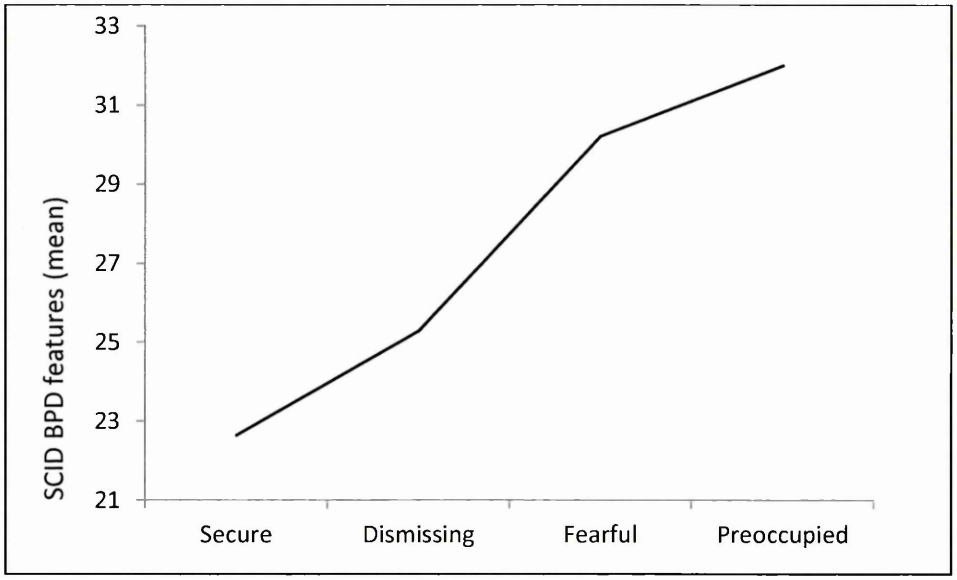


Figure D5.3 Mean BPD scores (as measured by the SCID) across the four attachment styles.

D.5.4.2 Attachment insecurity as mediator or moderator of BPD and negative evaluation of stimuli.

A hierarchical multiple regression model was used to examine possible contributions of BPD features and attachment insecurity to the overall negative rating of the vignettes (see Table D5.7). Due to a low sample size, bias-corrected bootstrap confidence intervals based on 5000 bootstrap samples were used. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity.

The BPD variable was entered in the first step and attachment anxiety and avoidance in the final step using the enter method. At the final step, it was found that BPD features and attachment avoidance and anxiety explained a significant amount of variance in overall negative ratings of the vignettes ($F(3,38) = 3.68$, $p = .02$, $R^2 = .23$, R^2 adjusted = .16). Attachment anxiety ($B = -.35$, $t = -2.19$, $p = .035$) was the only unique significant predictors of lower vignette ratings in the final step.

BPD features were not a significant predictor of overall vignette ratings, but this could be because of the relatively low prevalence of BPD features in this sample.

Table D5.7 Hierarchical Regression of BPD Features and Attachment Insecurity on Vignette Ratings.

	R	Beta (*SE*)	Standardised Beta	BCa 95% CI Lower, Upper	Adjusted R^2	*F*-Change
Step 1: BPD features	.25	-.67 (.43)	-.25	-1.54, .05	.04	2.63
Step 2: BPD features	.47	.21 (.53)	.08	-.90, 1.40	.16	4.01*
Attachment avoidance		-.24 (.12)*	-.29	-.48, .09		
Attachment anxiety		-.35 (.15)*	-.38	-.68, -.12		

Note: r^2 = .06 for step 1, p > .05), r^2 = .23 at step 2, p <. 05) (r^2 change = .17, p = .026)

To further explore how BPD and attachment anxiety are related to negative vignette appraisals, both a mediation and moderation analysis was conducted. A simple mediation analysis using ordinary least squares path analysis between BPD and overall vignette ratings with attachment anxiety as the mediating variable was conducted. The results can be seen in Table D5.8, and a conceptual diagram of the model can be seen in Figure D5.4. The results show that those with higher levels of BPD features report higher levels of attachment anxiety (a = 1.77, p < .001), and those with higher levels of attachment anxiety gave more negative ratings to the vignettes (b = -.34, p < .047). A bias corrected bootstrap confidence interval for the indirect effect (ab = -.60) was entirely below zero [-1.61, -.04], and the normal theory test (Sobel) approached significance (p = .066). Notably, analyses revealed that a multiple mediation model including both attachment avoidance and anxiety as mediators in the prediction of vignette ratings was not supported either by the normal theory Sobel test (-.25, z = -1.37, *ns*) or 95% bootstrap confidence intervals for avoidance, supporting the specificity of the model presented in Figure D5.4.

Consistent with the results from the regression analyses, it was concluded that attachment anxiety better explains negative ratings of abandonment and rejection based vignettes than BPD features.

Table D5.8 Mediation analysis of BPD, attachment anxiety, and vignette ratings.

Effect	Coefficient (*SE*)	CI 95% Lower, Upper
Total	-.67 (.41)*	-1.5, .164
Direct	-.07 (.49)	-1.07, .93
Indirect (mediation)	-.60 (.42)	-1.61, -.04

*p<.05, **p<.001

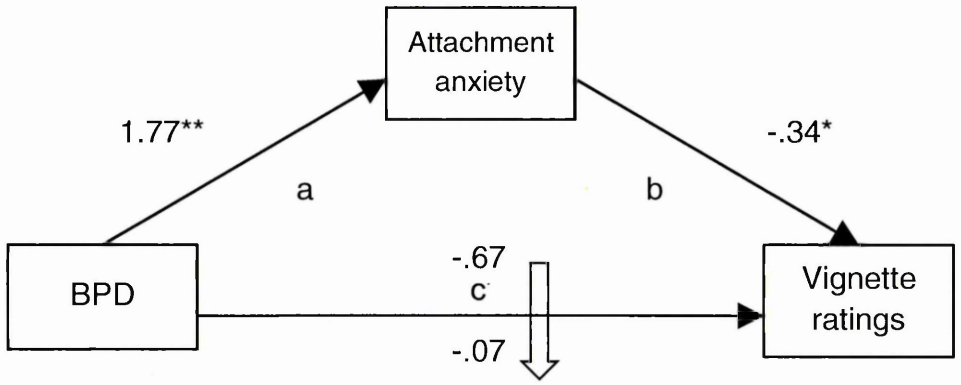


Figure D5.4 Conceptual diagram of BPD and vignette ratings mediated by attachment anxiety.

A moderation analysis was also conducted to examine how the interaction between BPD and attachment insecurity may affect overall vignette ratings (see Table D5.9). There was no evidence either attachment anxiety or avoidance moderating the relationship between BPD symptoms and vignette ratings, which further supports the specificity of the mediation model in Figure D5.4.

Table D5.9 Moderation Analysis of BPD, Attachment Anxiety, and Vignette Ratings.

Predictor	Coefficient (SE)	CI 95% Lower, Upper
Attachment anxiety	-.98 (.55)	-2.09, .14
Attachment avoidance	.39 (.59)	-.80, 1.59
BPD	-.54 (1.91)	-4.41, 3.33
Attachment anxiety x BPD interaction	.02 (.02)	-.02, .06
Attachment avoidance x BPD interaction	-.02 (.02)	-.06, .02

*$p < .05$, **$p < .001$

D.5.5 Discussion

The aims of this study were twofold, firstly it was designed to develop and validate the two bespoke tasks (the Stroop task and the vignette task). The words proposed for use in the attachment based Stroop task were independently rated for emotional valence, and as expected participants rated the positive, negative, and neutral groups of words as being significantly different in emotional valence. A brief pilot study of the final computerised version of the Stroop task confirmed that the task was working as intended. Six vignettes were also independently rated for negative content, and the results generally suggested that they are a valid way of manipulating self and other esteem and are therefore suitable for use in subsequent studies.

Secondly, it aimed to investigate the relationships among BPD features, attachment insecurity, and social cognition. Results supported the hypothesised that BPD features would be associated with attachment insecurity, particularly the fearful and preoccupied subtypes. The results also supported the hypothesis that attachment insecurity would mediate or moderate the relationship between BPD features and negative responses to the vignettes. Specifically, attachment anxiety better explains negative ratings of abandonment and rejection based vignettes than BPD features.

Limitations of the current study were that there was a relatively small sample of participants because this was a brief pilot study. However, these findings suggest that the catastrophic interpretations of ambiguous and abandonment/rejection related stimuli that are correlated with BPD features (e.g., Bowles et al., 2013) may function indirectly via attachment anxiety. One interpretation of these findings is that the presence of BPD features likely indicates high attachment anxiety, which in turn leads to increased reactivity to interpersonally stressful situations (Lazarus et al., 2014). High attachment anxiety in adults has also been shown to influence the prevalence of self-harm related thoughts (Levesque et al., 2010).

D.6 Vignettes and questions

Vignette 1: Ambiguous dinner scenario

It's a Friday evening and you are waiting for your partner to get home from work. You are feeling romantic this evening and have looked forward to a special, intimate evening with your partner. To prepare for this, you have made a lovely Italian meal and put some drinks in the fridge to chill. Your partner finally arrives, several hours late. He/she complains of having had a hard day and feels stressed. He/she then goes straight to the sofa and turns on the TV, without even looking at your meal or the drink.

1) How would you feel about yourself in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

2) How would you feel about your partner in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

3) I would expect that my partner will warm up to the idea of a romantic evening later on.

Very unlikely	1	2	3	4	5	6	Very likely

4) How certain are you that your partner went straight to the TV to avoid having to be with you?

Very certain	1	2	3	4	5	6	Not at all certain

5) Do you feel that your partner is fed up with you and might not love you as much as you love him/her?

Definitely	1	2	3	4	5	6	Definitely not

6) How confident are you that you could manage to turn this into a mutually enjoyable evening?

Very confident	1	2	3	4	5	6	Not at all confident

From "Attachment priming and avoidant personality features as predictors of social-evaluation biases", by D. P. Bowles and B. Meyer (2008), *Journal of Personality Disorders, 22*, 72-88. doi: 10.1521/pedi.2008.22.1.72

Vignette 2: Friendship abandonment scenario, (Sheets & Lugar, 2005)

Imagine that you've been under a lot of stress. Your parents are fighting so the tension is high at home. Your new boss constantly complains and has yelled at you twice this week.

You call your best friend to arrange for a night out, but your friend says he or she's got to study. The next day you find out your friend did not study but went out with others.

1) How would you feel about yourself in this situation?

Extremely positively negatively	1	2	3	4	5	6	Extremely

2) How would you feel about your friend in this situation?

Extremely positively negatively	1	2	3	4	5	6	Extremely

3) How concerned or anxious do you feel over whether or not your friend wants to spend time with you?

Very unconcerned	1	2	3	4	5	6	Very concerned

4) Do you feel that you were not welcome and that your friend has a personal grudge against you?

Definitely	1	2	3	4	5	6	Definitely not

5) How certain do you feel that your friend lied about studying to avoid spending time with you?

Very certain	1	2	3	4	5	6	Not at all certain

6) Would you confidently call another friend to arrange a night out?

Very confident	1	2	3	4	5	6	Not at all confident

From "Sources of conflict between friends in Russia and the United States" by V. L. Sheets and R. Luger, (2005), *Cross-Cultural Research, 39*. 380 – 398. doi: 10.1177/1069397105274833

Vignette 3: High-level threat of rejection (Besser & Priel, 2010)

You get out of work early one day and decide to surprise your partner with a present. As you walk up to the house, you hear laughing coming from inside. As you get closer, you see that the door is cracked open. You open the door to find your partner and another person having sex in the living room. You hear your partner whispering to this person: "I think I might be in love."

1) How would you feel about yourself in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

2) How would you feel about your partner in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

3) I would feel like my partner had betrayed me.

Definitely	1	2	3	4	5	6	Definitely not

4) How confident are you that you and your partner could work things out after this situation?

Very confident	1	2	3	4	5	6	Not at all confident

5) Do you feel that your partner must think there is something wrong with you?

Definitely	1	2	3	4	5	6	Definitely not

6) How certain do you feel that your partner loves this other person more than they love you?

Very certain	1	2	3	4	5	6	Not at all certain

From "Grandiose narcissism versus vulnerable narcissism in threatening situations: Emotional reactions to achievement failure and interpersonal rejection", by A. Besser and B. Priel, (2010), *Journal of Social and Clinical Psychology, 29*(8), 874 – 902. doi: 10.1521/jscp.2010.29.8.874

Vignette 4: Low-level threat of rejection (Besser & Priel, 2010)

You get out of work early and decide to surprise your partner with a present. As you walk up to the house, you hear some laughter coming from inside. As you get closer, you see that the door is cracked open. You open the door, to find your partner setting the table while the TV in the living room, which is on at high volume, is showing a laughing couple having sex.

1) How would you feel about yourself in this situation?

Extremely positively 1 2 3 4 5 6 Extremely negatively

2) How would you feel about your partner in this situation?

Extremely positively 1 2 3 4 5 6 Extremely

Negatively

3) I would feel very insecure about the relationship with my partner in this situation.

Definitely 1 2 3 4 5 6 Definitely not

4) How confident are you that you and your partner can still enjoy a nice evening together?

Very confident 1 2 3 4 5 6 Not at all confident

5) How concerned or anxious do you feel over your partner's behaviour in this situation?

Very unconcerned 1 2 3 4 5 6 Very concerned

6) How angry would you feel yourself getting about your partner's behaviour?

Not at all 1 2 3 4 5 6 Very much

From "Grandiose narcissism versus vulnerable narcissism in threatening situations: Emotional reactions to achievement failure and interpersonal rejection", by A. Besser and B. Priel, (2010), *Journal of Social and Clinical Psychology, 29*(8), 874 – 902. doi: 10.1521/jscp.2010.29.8.874

Vignette 5: Private interpersonal rejection (Besser & Ziegler-Hill, 2010)

Imagine that you and your romantic partner have got into a fight during a party with some of your friends. Your partner is so angry with you that he/she pulls you aside so that no one else can hear and tells you that he/she has been having an affair for the last few weeks because you have not been an adequate partner, and that he/she is going to leave you.

1) How would you feel about yourself in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

2) How would you feel about your partner in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

3) Do you feel that you and your partner could still enjoy the party after this situation?

Definitely	1	2	3	4	5	6	Definitely not

4) How certain do you feel that you and your partner can make up after this situation?

Very certain	1	2	3	4	5	6	Not at all certain

5) How concerned or anxious do you feel over your partner's behaviour in this situation?

Very unconcerned	1	2	3	4	5	6	Very concerned

6) How upset would you feel yourself getting about your partners behaviour?

Not at all	1	2	3	4	5	6	Very much

From "The influence of pathological narcissism on emotional and motivational responses to negative events: The roles of visibility and concern about humiliation", by A. Besser and V. Zeigler-Hill, (2010), *Journal of Research in Personality, 44*. 520 – 534. doi: 10.1016/j.jrp.2010.06.006

Vignette 6: Public interpersonal rejection (Besser & Ziegler-Hill, 2010)

Imagine that you and your romantic partner have got into a fight during a party with some of your friends. Your partner is so angry with you that he/she yells out to everyone that he/she has been having an affair for the last few weeks because you have not been an adequate partner and that he/she is going to leave you.

1) How would you feel about yourself in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

2) How would you feel about your partner in this situation?

Extremely positively	1	2	3	4	5	6	Extremely negatively

3) How certain do you feel that your partner will end the relationship?

Very certain	1	2	3	4	5	6	Not at all certain

4) How concerned or anxious do you feel about the reaction of your friends in this situation?

Very unconcerned	1	2	3	4	5	6	Very concerned

5) Do you feel that your partner deliberately wanted to humiliate you in front of your mutual friends?

Definitely	1	2	3	4	5	6	Definitely not

6) I would think that my partner was a horrible person for behaving like that.

Definitely	1	2	3	4	5	6	Definitely not

From "The influence of pathological narcissism on emotional and motivational responses to negative events: The roles of visibility and concern about humiliation", by A. Besser and V. Zeigler-Hill, (2010), *Journal of Research in Personality, 44*. 520 – 534. doi: 10.1016/j.jrp.2010.06.006

D.6.1 Supplementary data for vignette rating pilot study.

The ambiguous dinner scenario appeared to have a negative impact on self and other esteem with the mean score towards the negative end of the scale (see table D5.1). Additionally, 90.5% of the sample rated self-esteem and other esteem in the negative half of the scale and (ratings 1 - 3). The mean scores for the remaining four questions are generally higher and are more evenly distributed across the scale, but this is to be expected given that this particular vignette is designed to portray ambiguous and subtle cues of abandonment and rejection which appeal to BPD core specific beliefs. As such, a non-BPD sample may not perceive some or all of the cues present in the vignette and may not make excessively negatively appraisals. However, the results suggest that vignette 1: ambiguous dinner scenario is effective at eliciting low levels of self and other-esteem.

Table D6.1 Mean rating and standard deviation for the ratings of Vignette 1: ambiguous dinner scenario

Question	Min - Max	Mean (*SD*)
How would you feel about yourself in this situation? *(Extremely negatively - Extremely positively)*	1 - 5	2.21 (1.05)
How would you feel about your partner in this situation? *(Extremely negatively - Extremely positively)*	1 - 5	2.02 (1.00)
I would expect that my partner will warm up to the idea of a romantic evening later on. *(Very unlikely - Very likely)*	1 - 6	2.83 (1.48)
How certain are you that your partner went straight to the TV to avoid having to be with you? *(Very certain - Very uncertain)*	1 - 6	4.21 (1.60)
Do you feel that your partner is fed up with you and might not love you as much as you love him/her? *(Definitely - Definitely not)*	1 - 6	4.33 (1.60)
How confident are you that you could manage to turn this into a mutually enjoyable evening? *(Not at all confident - Very confident)*	1 - 6	3.52 (1.47)

The friendship abandonment scenario appeared to have a negative impact on self and other esteem with the mean score towards the negative end of the scale. Additionally, 90.5% of the sample rated self-esteem, and 100% rated other esteem in

the negative half of the scale and (ratings 1 - 3). The mean scores for the remaining four questions are generally higher, but show a trend towards the negative end of the scale (see table D6.2). The results suggest that vignette 2: friendship abandonment scenario is effective at eliciting low levels of self and other-esteem and can induce negative affective states.

Table D6.2 Mean rating and standard deviation for the ratings of Vignette 2: friendship abandonment scenario

Question	Min - Max	Mean (*SD*)
How would you feel about yourself in this situation? *(Extremely negatively - Extremely positively)*	1 - 4	1.83 (1.03)
How would you feel about your friend in this situation? *(Extremely negatively - Extremely positively)*	1 - 3	1.45 (.63)
How concerned or anxious do you feel over whether or not your friend wants to spend time with you? *(Very concerned - Very unconcerned)*	1 - 6	2.62 (1.65)
Do you feel that you were not welcome and that your friend has a personal grudge against you? *(Definitely - Definitely not)*	1 - 5	2.74 (1.42)
How certain do you feel that your friend lied about studying to avoid spending time with you? *(Very certain - Very uncertain)*	1 - 5	2.24 (1.12)
Would you confidently call another friend to arrange a night out? *(Not at all confident - Very confident)*	1 - 6	3.50 (1.58)

The high level threat of interpersonal rejection scenario also appeared to have a negative impact on self and other esteem with the mean score towards the negative end of the scale (see table D6.3). Additionally, 92.9% of the sample rated self-esteem, and 100% rated other esteem in the negative half of the scale and (a score of 1 or 2). The mean scores for the remaining four questions are generally quite low, but show a trend towards the negative end of the scale. The results suggest that vignette 3: high level threat of interpersonal rejection is effective at eliciting low levels of self and other-esteem and can induce negative affective states.

Table D6.3 Mean rating and standard deviation for the ratings of Vignette 3 high level threat of interpersonal rejection scenario

Question	Min - Max	Mean (*SD*)
How would you feel about yourself in this situation? *(Extremely negatively - Extremely positively)*	1 - 6	1.86 (1.20)
How would you feel about your partner in this situation? *(Extremely negatively - Extremely positively)*	1 - 2	1.10 (.30)
I would feel like my partner had betrayed me. *(Definitely - Definitely not)*	1 - 3	1.07 (.34)
How confident are you that you and your partner could work things out after this situation? *(Not at all confident -Very confident)*	1 - 5	1.38 (.88)
Do you feel that your partner must think there is something wrong with you? *(Definitely - Definitely not)*	1 - 6	2.90 (1.64)
How certain do you feel that your partner loves this other person more than they love you? *(Very certain - Very uncertain)*	1 - 6	2.81 (1.73)

The low level threat of interpersonal rejection also appeared to have a negative impact on self and other esteem with the mean score towards the negative end of the scale (see table D6.4). Additionally, 42.9 % of the sample rated self-esteem in the negative half of the scale and (ratings 1 - 3) and 42.9% of participants rated other-esteem as negatively (1 - 3). The mean scores for the remaining four questions are generally higher, but show a trend towards the positive end of the scale. a non-BPD sample may not perceive some or all of the cues present in the vignette and may not make excessively negatively appraisals. The results suggest that vignette 4: low level threat of interpersonal rejection is effective at eliciting low levels of self and other-esteem and can induce negative affective states.

Table D6.4 Mean rating and standard deviation for the ratings of Vignette 4 low level threat of interpersonal rejection scenario

Question	Min - Max	Mean (*SD*)
How would you feel about yourself in this situation? *(Extremely negatively - Extremely positively)*	1 - 6	3.81 (1.44)
How would you feel about your partner in this situation? *(Extremely negatively - Extremely positively)*	1 - 6	3.86 (1.44)
I would feel very insecure about the relationship with my partner in this situation. *(Definitely - Definitely not)*	1 - 6	4.19 (1.64)
How confident are you that you and your partner can still enjoy a nice evening together? *(Not at all confident - Very confident)*	1 - 6	4.62 (1.32)
How concerned or anxious do you feel over your partner's behaviour in this situation? *(Very concerned - Very unconcerned)*	1 - 6	4.24 (1.62)
How angry would you feel yourself getting about your partner's behaviour? *(Very much - Not at all)*	1 - 6	4.67 (1.66)

The private interpersonal rejection vignette appeared to have a negative impact on self and other esteem with the mean score towards the negative end of the scale (see table D6.5). Additionally, 65% of the sample rated self-esteem in the negative half of the scale and (ratings 1 - 3) and 100% of participants rated other-esteem as extremely negatively (a score of). The mean scores for the remaining four questions are generally higher, but show a trend towards the negative end of the scale. The results suggest that vignette 5: private interpersonal rejection is particularly effective at eliciting low levels of self and other-esteem and can induce negative affective states.

Table D6.5 Mean rating and standard deviation for the ratings of Vignette 5 private interpersonal rejection scenario

Question	Min - Max	Mean (*SD*)
How would you feel about yourself in this situation? *(Extremely negatively - Extremely positively)*	1 - 5	1.52 (1.04)
How would you feel about your partner in this situation? *(Extremely negatively - Extremely positively)*	1 - 3	1.12 (.40)
Do you feel that you and your partner could still enjoy the party after this situation? *(Definitely not – Definitely)*	1 - 2	1.02 (.15)
I would think my partner's behaviour is completely unacceptable. *(Definitely - Definitely not)*	1 - 2	1.29 (.92)
How certain do you feel that you and your partner can make up after this situation? *(Very uncertain - Very certain)*	1 - 2	1.10 (.30)
How upset would you feel yourself getting about your partners behaviour? *(Very much - Not at all)*	1 - 5	1.21 (.78)

The public interpersonal rejection vignette appeared to have a negative impact on self and other esteem with the mean score towards the negative end of the scale (see table D6.6). Additionally, 100% of the sample rated self-esteem in the negative half of the scale and (ratings 1 - 3) and 100% of participants rated other-esteem as extremely negatively (a score of 1-3). The results suggest that vignette 5: private interpersonal rejection is particularly effective at eliciting low levels of self and other-esteem and can induce negative affective states.

Table D6.6 Mean rating and standard deviation for the ratings of Vignette 6 public interpersonal rejection scenario

Questions	Min - Max	Mean (*SD*)
How would you feel about yourself in this situation? *(Extremely negatively - Extremely positively)*	1 - 3	1.31 (.60)
How would you feel about your partner in this situation? (Extremely negatively - Extremely positively)	1 - 3	1.07 (.34)
How certain do you feel that your partner will end the relationship? *(Very certain - Not at all certain)*	1 - 6	1.64 (1.46)
How concerned or anxious do you feel about the reaction of your friends in this situation? *(Very concerned - Very unconcerned)*	1 - 6	2.43 (1.78)
Do you feel that your partner deliberately wanted to humiliate you in front of your mutual friends? *(Definitely - Definitely not)*	1 - 6	1.71 (1.22)
I would think that my partner was a horrible person for behaving like that. *(Definitely - Definitely not)*	1 - 4	1.36 (.69)

D.6.2 Supplementary data for the Stroop task.

Table D6.7 Word length and frequency data for Stroop task words

Word	Length	BNC	KF-Freq	TL-Freq
Trustworthy	11	149	3	13
Thoughtless	11	96	3	17
Observatory	11	219	3	5
Responsive	10	626	4	21
Possessive	10	197	4	20
Embankment	10	349	4	5
Nurture	7	164	4	10
Jealous	7	916	4	183
Plumber	7	214	4	28
Loyal	5	1330	18	91
Cruel	5	1321	15	165
Lemon	5	1209	18	301
Embrace	7	940	13	114
Neglect	7	1187	12	192
Mineral	7	1195	12	48
Calm	4	2780	35	267
Hurt	4	4299	37	725
Gate	4	3430	37	311
Warm	4	6744	67	718
Cold	4	11659	171	1092
Farm	4	6770	96	826
Safe	4	6671	58	550
Loss	4	11475	86	352
Foot	4	7249	70	505
Adore	5	157	2	197
Needy	5	247	6	20
Blink	5	218	4	83
Trust	5	9991	52	418
Avoid	5	7840	58	370
Phone	5	7648	54	272
Close	5	20780	234	1862
Alone	5	12228	195	1315
Table	5	19305	198	1325
Loving	6	1409	15	101
Reject	6	1524	10	51
Button	6	1629	10	196
Secure	6	4548	30	353
Threat	6	5565	42	108
Branch	6	5409	33	254
Comfort	7	3246	43	508

Divorce	7	2022	29	312
Counter	7	2409	31	117
Protect	7	5047	34	383
Distant	7	2772	37	205
Vehicle	7	417	35	
Confide	7	160	3	100
Abandon	7	1294	17	150
Coconut	7	318	7	82
Support	7	29568	180	453
Despair	7	1427	21	157
Account	7	15668	117	660
Intimate	8	1153	21	172
Distress	8	1455	15	131
Announce	8	1098	18	350
Reassure	8	582	1	65
Insecure	8	330	3	7
Cosmetic	8	391	1	37
Dependable	10	129	8	32
Heartbreak	10	114	1	23
Roundabout	10	544	2	15
Sympathetic	11	1485	35	99
Destructive	11	778	25	28
Electronics	11	1477	32	

Note: BNC = British National Corpus frequcny; K-F-FREQ = Kucera & Francis (1967) written frequencies of occurrence in American English, T-L-FREQ = Thorndike-Lorge (1944) written frequencies. Data taken from the MRC psycholinguistic database (Coltheart, 1981). Positive attachment words are highlighted in green, negative attachment words are highlighted in red, and neutral words are highlighted in yellow.

For the 21 negative attachment-related words, ratings can be seen in table D6.8. Lower scores correspond to a more negative rating, whereas high scores correspond to a positive rating. The mean rating for each of the 21 negative words indicates that participants generally considered the words to be somewhat unpleasant, or very unpleasant. Cronbach's alpha was .77, suggesting that the ratings for the words are internally reliable.

Table D6.8 Ratings for each of the individual negative attachment-related words

Word	Min - Max	Mean rating (*SD*)
Abandon	1 - 3	1.38 (.54)
Alone	1 - 4	2.00 (.86)
Avoid	1 - 3	2.36 (.58)
Cold	1 - 4	2.31 (.78)
Cruel	1 - 3	1.24 (.48)
Despair	1 - 3	1.48 (.67)
Destructive	1 - 4	1.71 (.74)
Distant	1 - 3	2.02 (.64)
Distress	1 - 3	1.45 (.59)
Divorce	1 - 4	1.76 (.79)
Heartbreak	1 - 2	1.14 (.35)
Hurt	1 - 2	1.31 (.47)
Insecure	1 - 2	1.38 (.49)
Jealous	1 - 3	1.69 (.52)
Loss	1 - 3	1.43 (.55)
Needy	1 - 3	1.98 (.60)
Neglect	1 - 2	1.26 (.45)
Possessive	1 - 3	1.74 (.63)
Reject	1 - 3	1.57 (.59)
Threat	1 - 3	1.45 (.55)
Thoughtless	1 - 5	1.88 (.67)

For the 21 positive attachment-related words, ratings can be seen in table D6.9. Lower scores correspond to a more negative rating, whereas high scores correspond to a positive rating. The mean rating for each of the 21 positive words indicates that participants generally considered the words to range from neutral to very pleasant. Cronbach's alpha was .90, suggesting that the ratings for the words are internally reliable.

Table D6.9 Ratings for each of the individual positive attachment-related words

Word	Min - Max	Mean rating (*SD*)
Adore	3 - 5	4.69 (.56)
Calm	3 - 5	4.12 (.63)
Close	2 - 5	3.40 (.73)
Comfort	4 - 5	4.40 (.50)
Confide	2 - 5	3.74 (.70)
Dependable	1 - 5	3.76 (.96)
Embrace	3 - 5	4.43 (.63)
Intimate	1 - 5	3.95 (1.06)
Loving	2 - 5	4.74 (.59)
Loyal	2 - 5	4.62 (.66)
Nurture	3 - 5	4.31 (.68)
Protect	3 - 5	4.29 (.55)
Reassure	3 - 5	4.17 (.62)
Responsive	2 - 5	3.88 (.59)
Safe	3 - 5	4.52 (.59)
Secure	3 - 5	4.50 (.60)
Support	2 - 5	4.31 (.68)
Sympathetic	2 - 5	4.24 (.69)
Trust	2 - 5	4.36 (.69)
Trustworthy	3 - 5	4.50 (.55)
Warm	2 - 5	4.29 (.64)

For the 21 neutral words, ratings can be seen in table D6.10. Lower scores correspond to a more negative rating, whereas high scores correspond to a positive rating. The mean rating for each of the 21 neutral words is close to 3, indicating that participants generally considered the words to be neutral. Cronbach's alpha was .60, suggesting that the ratings for the words are internally reliable.

Table D6.10 Ratings for each of the individual neutral words

Word	Min - Max	Mean rating (*SD*)
Account	2 - 3	2.88 (.32)
Announce	1 - 4	3.05 (.54)
Blink	2 - 3	2.95 (.22)
Branch	2 - 4	3.05 (.38)
Button	3 - 5	3.21 (.52)
Coconut	2 - 5	3.48 (.71)
Cosmetic	1 - 5	3.17 (.73)
Counter	2 - 5	3.02 (.35)
Electronics	2 - 5	3.07 (.56)
Embankment	3 - 4	3.05 (.22)
Farm	3 - 5	3.48 (.59)
Foot	1 - 4	2.90 (.48)
Gate	3 - 5	3.07 (.34)
Lemon	2 - 4	3.10 (.48)
Mineral	3 - 5	3.12 (.40)
Observatory	2 - 4	3.24 (.48)
Phone	1 - 4	2.95 (.49)
Plumber	2 - 3	2.95 (.22)
Roundabout	2 - 4	3.05 (.44)
Table	3 - 4	3.07 (.26)
Vehicle	2 - 4	3.05 (.31)

Appendix E Supplementary material for Study 3

E.1 Ethical approval

Sheffield Hallam University

Our Ref AM/SW/61-DRA

8th April 2015

Jennifer Drabble
Heart of the Campus
Collegiate Crescent Campus
INTERNAL

Dear Jennifer

Request for Ethical Approval of Research Project
Your research project entitled "**Borderline personality features (BPD) and self-harm: self-esteem and adult attachment as mediators and moderators**" has been submitted for ethical approval to the Faculty's reviewers and I am pleased to confirm that they have approved your project.

I wish you every success with your research project.

Yours sincerely

Ann Macaskill

Professor A Macaskill
Chair
Faculty Research Ethics Committee

Office address :
Business Support Team
Faculty of Development & Society
Sheffield Hallam University
Unit 4, Sheffield Science Park
Howard Street, Sheffield, S1 1WB
Tel: 0114-225 3308
E-mail: DS-ResearchEthics@shu.ac.uk

E.2 Call for participants

I'm currently a PhD student at Sheffield Hallam University (under the supervision of Dr David Bowles), and I'm interested in self-harm behaviours and how they relate to personality styles. I'm looking for participants to take part in an online questionnaire, you will be asked to complete a number of questionnaires which ask about your thoughts, feelings, and behaviours. You will also be asked to complete a brief arithmetic task, and then read a number of scenarios and answer some questions afterwards. This should take no longer than 25 minutes. This study is completely anonymous; no identifying information is gathered at all, and so there is no possibility that the data you provide will be tracked or somehow traced to you. In addition, this study has been approved by the Sheffield Hallam University institutional ethical review board.

Please note that this study contains questions about self-harm, which you may find distressing and/or triggering. The section directly related to self-harm will be clearly marked, and you are under no obligation to answer any of the questions. So please take care and keep safe if you do decide to take part.
Thank you!

E.3 Participant information sheet and informed consent

The role of attachment, self-esteem and personality in self-harm.

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it would involve.

Please note that this study contains question about self-harm, which some may find distressing and/or triggering. The section directly related to self-harm will be clearly marked, and you are under no obligation to answer any of the questions. If you are negatively affected by any of the questions in this study and feel that you may require help, please contact the UK charity The Samaritans on +448457 90 90 90 or by email at jo@samaritans.org.

What is the purpose of this study?

The aim of this study is to investigate how attention, attachment, self-esteem and personality traits are related to self-harm type behaviours. The data you provide will primarily be used as the basis of the principal investigator's PhD thesis.

Do I have to take part?

Your participation is voluntary. You can leave the study at any time without being penalised or disadvantaged in any way, even if you have already completed some or all of the tasks. If you choose to leave the study before completion, your data will be destroyed and not used in any subsequent analyses. Please note that once data collection has been completed, all data will be anoynmised. You cannot withdraw your data after this, as we can no longer identify which data belongs to which participant.

What will I have to do if I decide to participate?

If you decide to participate in this study; you will be asked to complete a number of questionnaires which ask about your thoughts, feelings, and behaviours. You will also be asked to complete a brief arithmetic task, and then read a number of scenarios and answer some questions afterwards. This should take no longer than 25 minutes.

Who has reviewed the study?

This research project has been reviewed and approved by the Research Ethics Committee at Sheffield Hallam University (pending)

What are the risks and advantages of participating?

Please note that this study contains questions and discussion about self-harm, which some may find distressing and/or triggering. Before participating, you should consider if discussing self-harm may put you at any risk. If you think this may be the case, then please do not volunteer to participate as your personal safety is paramount. If at any time you feel uncomfortable, you can refuse to answer any (or all) questions and withdraw from the study by exiting your browser.

We cannot guarantee any direct benefits as a result of participating in this study, however you will help to inform future research and treatment interventions for self-harm.

Will my taking part in the study be kept confidential?

Any information you provide is confidential, and will only be available to the principal researcher. Once collected, the data you provide will be anonymous. No information that could lead to your identification will be gathered or disclosed.

Digital data will be stored securely on the university servers. Aggregated results may be published in academic journals and made available to the wider community by being deposited in appropriate data archives.

For further information about this research project, please contact the principal researcher Jennifer Drabble.

Email: j.drabble@shu.ac.uk. **Tel:** 01142252434

Address: Sheffield Hallam University, Department of Psychology, Sociology & Politics, Faculty of Development & Society, Room HC.1.05, Heart of the Campus Building, Collegiate Crescent, Collegiate Campus, Sheffield, S10 2BQ

Title of Project: The role of attachment, self-esteem, and personality in self-harm.

Name of Researcher: Jennifer Drabble

Please tick each box:

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information and ask any questions.
2. I understand there may be discussion of sensitive topics, and that I can immediately terminate my participation at any point without giving explanation.
3. I understand that all information I give will be confidential and only accessible to the research team.
4. I understand that my participation is voluntary and that I am free to decline to answer any or all questions. I understand that I am free to withdraw at any time without giving a reason.
5. I agree to take part in the above research project and give my informed consent for my data to be used in future publications.

By proceeding and completing the questionnaire on the following pages, I indicate my consent to participate. Please click the 'Next' button when you are ready to begin.

E.4 Debriefing information

Thank you for giving up your time to participate in this study! This study is investigating how cognition and personality traits are related to self-harm type behaviours.

Please note that the reaction time feedback you received after the arithmetic task was not a true measure of your performance, but had been manipulated as part of the study.

If you have any concerns about your behaviour, you can contact your doctor/GP or a healthcare professional for advice. Alternatively you can contact the UK charity The Samaritans on +448457 90 90 90 or by email at jo@samaritans.org for anonymous advice.

If you are a student of Sheffield Hallam University and require guidance, you can contact the student wellbeing reception for guidance and advice via telephone on: 0114 225 2136 or by email: student.wellbeing@shu.ac.uk

Please direct any concerns or questions about this study to the principal researcher, Jennifer drabble in the first instance or the research supervisor Dr David Bowles if they cannot be addressed. Contact details are below.

Contact details and useful information:

Principal Researcher: Jennifer Drabble

PhD Researcher at Sheffield Hallam University

j.drabble@shu.ac.uk

Contact address: Sheffield Hallam University, Department of Psychology, Sociology & Politics, Faculty of Development & Society, Room HC.1.05, Heart of the Campus Building, Collegiate Crescent, Collegiate Campus, Sheffield, S10 2BQ

Telephone: 01142252434

Under the supervision of: Dr. David Bowles

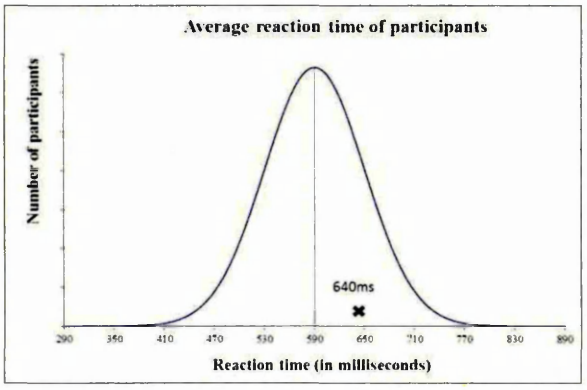
d.p.bowles@shu.ac.uk

E.5 False feedback

Sheffield Hallam University

The graph below show the average reaction times (the time between from seeing each arithmetic problem to typing in your answer) for all the people who have participated in this task so far. Scores to the left of the graph indicate faster reaction times, and scores to the right represent slower reaction times.

Your average reaction time was 640ms. This is slightly slower than average for performance on this task.



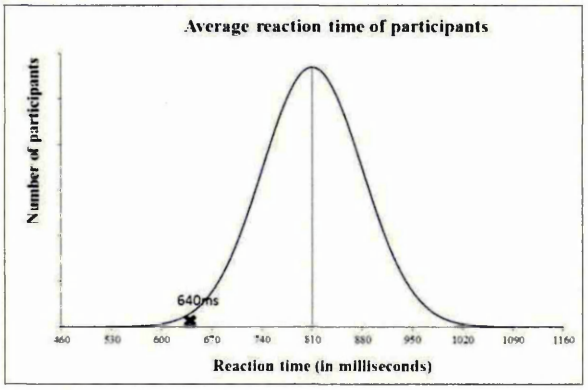
Please click the Next button when you are ready to continue.

Figure E1 Neutral/ambiguous feedback

Sheffield Hallam University

The graph below show the average reaction times (the time between from seeing each arithmetic problem to typing in your answer) for all the people who have participated in this task so far. Scores to the left of the graph indicate faster reaction times, and scores to the right represent slower reaction times.

Your average reaction time was 640ms. This puts you in the top 10% of participants. Well done!



Please click the Next button when you are ready to continue.

Figure E2 Positive feedback condition